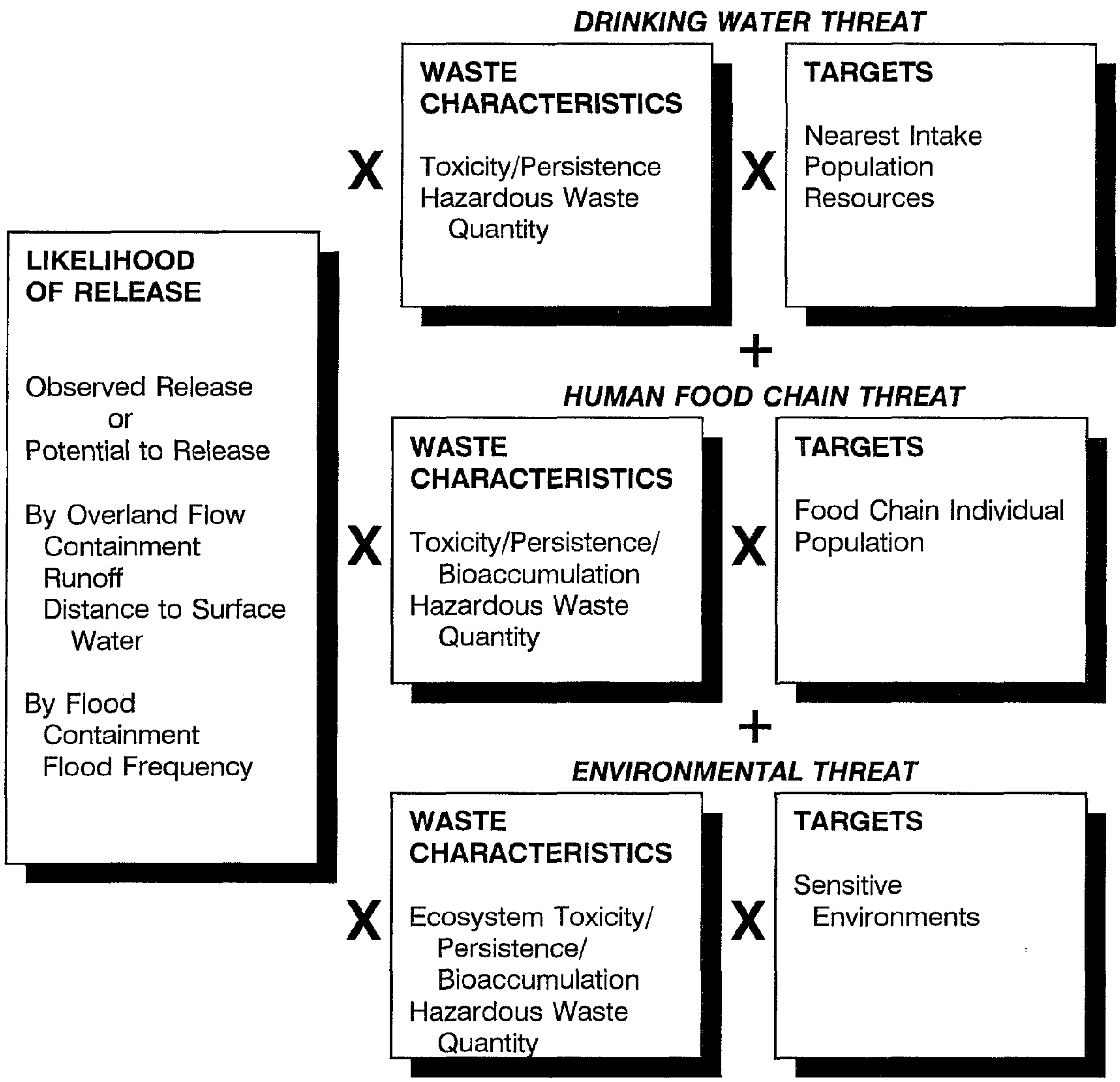
CHAPTER 8
SURFACE WATER PATHWAY



SECTION 8.1
HAZARDOUS SUBSTANCE MIGRATION PATH

This section explains how to determine the hazardous substance migration path of the overland/flood component of the surface water pathway, including how to determine the overland and in-water segments, and how to identify the PPE and TDL. The guidance in this section does not apply to the ground water to surface water component of the surface water pathway.

RELEVANT HRS SECTIONS

Section 4.0.2	Surface water categories
Section 4.1.1.1	Definition of the hazardous substance migration path for overland flow/flood migration component
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.2.1.2	Runoff
Section 4.1.2.1.2.1.3	Distance to surface water

DEFINITIONS

Hazardous Substance Migration Path: The path that hazardous substances travel or would travel over land from a source to surface water (overland segment) and within surface water to the TDL (in-water segment). In certain cases (e.g., sites consisting only of contaminated sediments, sites where sources are located in surface water bodies), the hazardous substance migration path consists of only an in-water segment.

Intermittent Water Body: Water bodies that do not contain water during all seasons of the year under normal conditions.

In-water Segment: Portion of the hazardous substance migration path from the PPE to the TDL. For tidally influenced rivers, the in-water segment may include portions of surface water bodies upstream from the PPE to the extent that the in-water migration path is reversed by tides. For contaminated sediments with no identified source, the in-water segment begins at the upstream boundary (for streams and rivers) or center (for water bodies with no direction of flow) of the area of contaminated sediments.

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

Overland Segment: Portion of the hazardous substance migration path from a source to a surface water body.

Perennial Water Body: Contains water throughout the year under normal conditions. Under extreme conditions (e.g., severe drought) some water bodies considered perennial may not contain water.

Probable Point of Entry (PPE): Point at which the overland segment of a hazardous substance migration path intersects with surface water. A site may have multiple PPEs. The PPE is assigned as the point at which entry of the hazardous substances to surface water is most likely.

Surface Water: Water present at the earth's surface. Surface water includes rivers, lakes, oceans, ocean-like water bodies, and coastal tidal waters, as defined in HRS section 4.0.2.

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Watershed: Portion of the watershed downgradient of sources at the site. The watershed includes the surface water bodies between the PPEs and the TDL (i.e., the in-water segment of the hazardous substance migration path). A single watershed includes all in-water segments that intersect within the TDL. A site is in two or more watersheds if two or more hazardous substance migration paths from the sources do not reach a common point within the TDL. In these cases, each distinct watershed is evaluated separately.

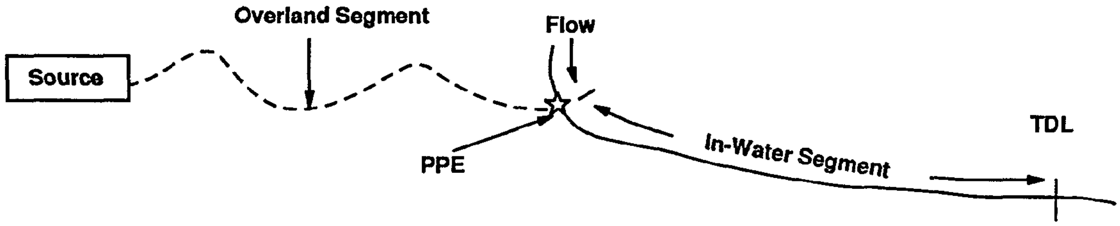
DELINEATING THE OVERLAND SEGMENT

The overland segment is used to evaluate potential to release to surface water and establish the PPE. In the simplest case, a site will have one source with a single hazardous substance migration path, with a single overland segment (see ***Highlight 8-1***). Because the overland segment is defined from a source to surface water, a single site with multiple sources may have more than one hazardous substance migration path, and hence more than one overland segment (although they may be very near to one another and/or may converge). The steps below apply to sources in a single watershed. These steps should be repeated for each source within the watershed and for each watershed.

(1) **Identify each source at the site with a containment factor value greater than 0 for the surface water pathway.** Do not evaluate sources with a surface water containment factor value of 0.

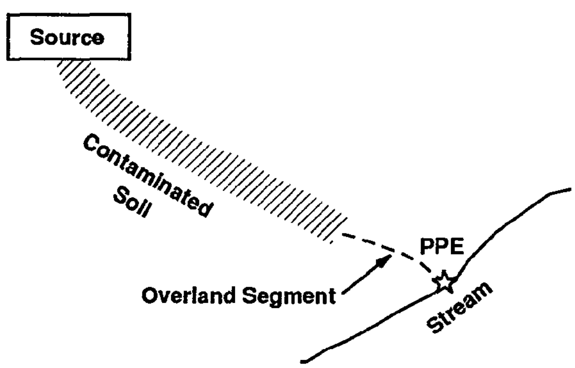
- In general, each source serves as the beginning of an overland segment.
- Sometimes hazardous substances will have already migrated from the source toward surface water. If evidence of this migration is contaminated soil, the contaminated soil is itself a source. Use the farthest point of documented soil contamination as the beginning of the overland segment (see ***Highlight 8-2***).
- If a site consists of contaminated sediments with no identifiable source, then there is no overland segment.

HIGHLIGHT 8-1
HAZARDOUS SUBSTANCE MIGRATION PATH



- The hazardous substance migration path is comprised of two segments: an overland segment and in-water segment.
- The overland segment extends from the source to the PPE.
- The in-water segment extends from the PPE to the TDL.
- The overland segment determines the distance to surface water; the in-water segment determines the targets that will be evaluated.

HIGHLIGHT 8-2
OVERLAND SEGMENT FOR CONTAMINATED SOILS



If hazardous substances have started to migrate toward surface water, the overland segment is the distance from the contaminated soil to surface water.

The contaminated soil must be attributed to a source associated with the site being evaluated.

- **Determine the overland flow paths that surface water would take from a source to a surface water body.** Delineate the overland segment by determining the routes that runoff would take from a source to surface water. The routes may be determined solely from topographic maps; however, the overland segment generally should be refined from site observations.

- Storm sewers and other covered drains (or other man-made runoff controls, such as a wall) along the overland migration path must be considered in determining the overland flow (see ***Highlight 8-3***).

- If contaminated soil is directly adjacent to the PPE, the distance to surface water is 0.

- At sites with a large source and/or complex topography, there may be more than one overland segment from a single source in a single watershed.

If all the overland segments are greater than 2 miles, assign a value of 0 for the potential to release by overland flow component. However, potential to release by flood can still be evaluated for that watershed, if applicable.

(3) **Identify the PPE.** The PPE is the point where the overland segment reaches an eligible surface water body. Eligible surface waters are listed in ***Highlight 8-4***.

- ***Highlight 8-5*** provides additional guidance on determining the PPE for water bodies with wetlands and for intermittently flowing streams and ditches.

- At sites with a large source and/or complex topography, there may be more than one PPE to a single surface water body (see ***Highlight 8-6***).

SCORING THE DISTANCE TO SURFACE WATER FACTOR

Evaluate the distance to surface water factor only for watersheds scored based on potential to release by overland flow. Do not evaluate this factor for watersheds where an observed release to surface water has been documented.

(1) **Determine the shortest overland segment from any source with a containment factor value greater than 0 to the surface water body.** If this distance is near a breakpoint between distance ranges in HRS Table 4-7, use the mean high water level for tidal waters or the mean water level for other surface waters.

HIGHLIGHT 8-3
CHARACTERIZATION OF THE OVERLAND SEGMENT FOR STORM SEWERS AND COVERED DRAINS

Storm sewers and other covered drains along the overland migration pathway have proved difficult to characterize for two reasons:

(2) **Where does the drain discharge come out?** Engineering drawings and/or dye tests can help determine the migration path through the drain.

(3) **Are the hazardous substances coming out the far end of the drain attributable to the sources at the site?** To strengthen the attribution of the hazardous substances to the site:

— Carefully document the storm drain's pathway and connections.

— Evaluate the contribution of other potential sources to the drain.

—- Show similarity between the materials from the site that enter the drain and those that come out.

See Section 5.1 for additional guidance concerning attribution.

HIGHLIGHT 8-4
ELIGIBLE SURFACE WATERS

HRS section 4.0.2 identifies and categorizes surface water for HRS purposes. Additional guidance on distinguishing among these types of surface waters is provided in Section 8.2.

Rivers Include:

- Perennially flowing waters from point of origin to the ocean or to coastal tidal waters;
- Wetlands contiguous to perennially flowing waters;
- Above ground portions of disappearing rivers;
- Man-made ditches that perennially flow into other surface water; and
- Intermittently flowing waters and contiguous intermittently flowing ditches, in arid or semi-arid areas with less than 20 inches of mean annual precipitation.

Lakes Include:

- Natural and man-made lakes (including impoundments) that lie along rivers, but excluding the Great Lakes;
- Isolated, but perennial lakes, ponds, and wetlands;
- Static water channels or oxbow lakes contiguous to rivers;
- Small rivers, without diking, that merge into surrounding perennially inundated wetlands; and
- Wetlands contiguous to water bodies defined as lakes.

Ocean and ocean-like water bodies Include:

- Ocean areas seaward from the baseline of the Territorial Sea (I.e., seaward from the generalized coastline of the United States);
- The Great Lakes; and
- Wetlands contiguous to the Great Lakes.

Coastal tidal waters Include:

- Waters that are seaward from mouths of rivers and landward from the baseline of the Territorial Sea (e.g., embayments, harbors, sounds, estuaries, back bays, lagoons, wetlands).

Surface waters specifically excluded from evaluation as surface water bodies for HRS purposes Include:

- Intermittent rivers in areas with 20 or more inches mean annual precipitation; and
- Intermittent ponds or lakes, regardless of mean annual precipitation.

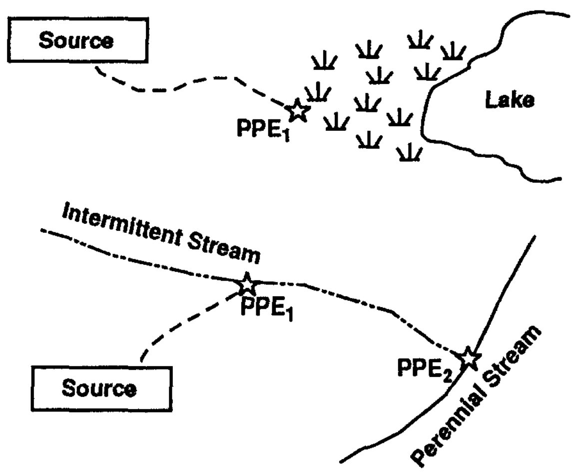
- If there is only one overland segment, the distance to surface water is the distance from a source to the PPE, measured along the overland segment.

- If there are two or more overland segments, the distance to surface water is the shortest distance from any source to the PPE for the watershed being evaluated.

  — If the in-water segments associated with different overland segments reach a common point within the TDL, select the shortest overland segment, and use its length as the distance to surface water (see ***Highlight 8-6***).

  — If the in-water segments associated with different overland segments do not reach a common point within the TDL, the site is in more than one watershed (see ***Highlight 8-6***). Assign a separate distance to surface water factor and calculate a separate surface water pathway score for each watershed. Section 8.2 provides guidance on scoring sites with more than one watershed.

HIGHLIGHT 8-5
PROBABLE POINT OF ENTRY
FOR WETLANDS AND INTERMITTENT STREAMS



A wetland contiguous to river, lake, or coastal tidal water is considered to be surface water. PPE_1 is where the overland segment meets the wetland.

Intermittently flowing streams and ditches are considered surface water only in arid areas with less than 20 inches mean annual precipitation. PPE_1 is the PPE in such areas. PPE_2 is the PPE in areas with 20 inches or more mean annual precipitation.

(2) **If the shortest overland segment for a watershed exceeds 2 miles, potential to release by overland flow cannot be evaluated for the watershed.** Assign potential to release by overland flow a value of 0 for the watershed.

(3) **Assign a distance to surface water factor value using HRS Table 4-7.** Because this factor is assigned based on distance ranges, precise measurement of the distance of the overland segment is generally not necessary unless the distance is near a breakpoint between two ranges.

SCORING THE FLOOD FREQUENCY FACTOR

(1) **Determine the floodplain category (i.e., floods annually, 10-year, 100-year, 500-year) in which the source is partially or wholly located.** Potential to release by flood does not consider distance to surface water. Therefore, a source with an overland segment greater than 2 miles can be evaluated if it is located in an appropriate floodplain.

(2) **Assign a flood frequency factor value using HRS Table 4-9.**

EVALUATING THE TARGET DISTANCE LIMIT FOR NON-TIDALLY INFLUENCED WATER BODIES

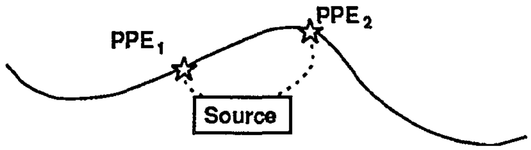
This section discusses determining the TDL for sites with and without a PPE, sites with multiple PPEs, and sites where the in-water segment branches.

A. SITES WITH A SINGLE PPE

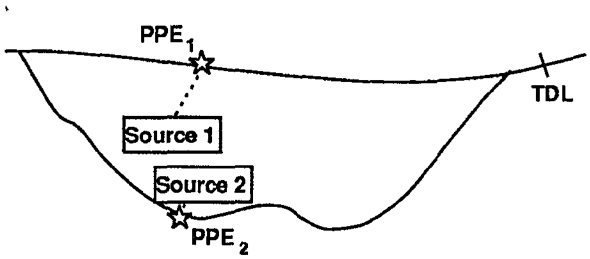
(A1) **Determine the PPE, based on delineation of the overland flow segment.**

(A2) **Measure the distance along each surface water body.** Measure from the PPE to the most distant sampling point that meets the observed release criteria (downstream for rivers and streams; or radially for lakes, oceans, and coastal tidal waters).

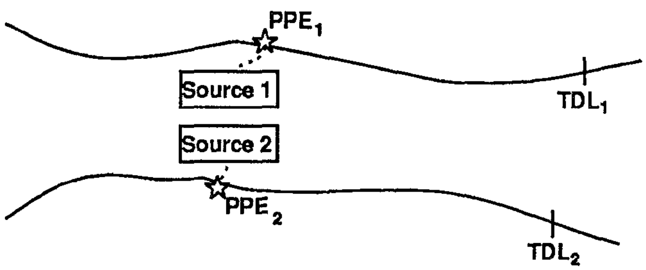
HIGHLIGHT 8-6
PROBABLE POINT OF ENTRY AND TARGET DISTANCE LIMIT FOR SITES WITH MORE THAN ONE OVERLAND SEGMENT



Use the distance of the shortest overland segment to assign the distance to surface water factor value.



The in-water segments for Sources 1 and 2 reach a common point within the TDL. Source 1 and Source 2 are in the same watershed.



The in-water segments for Source 1 and Source 2 do not reach a common point within the TDL. Source 1 and Source 2 are in different watersheds.

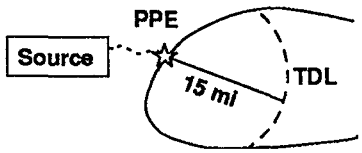
- If no sample meets the observed release criteria or if the most distant sample that meets this criteria is less than 15 miles from the PPE (measured along the surface water body), extend the TDL to 15 miles from the PPE (see ***Highlight 8-7***).

- If the most distant sample that meets the observed release criteria is more than 15 miles from the PPE (measured along the surface water body), extend the TDL to that point (see ***Highlight 8-8***).

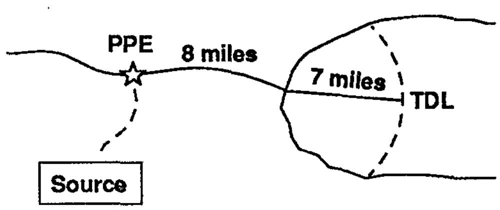
(A3) **Evaluate those surface water targets that are located partially or wholly within, or contiguous to, the TDL.**

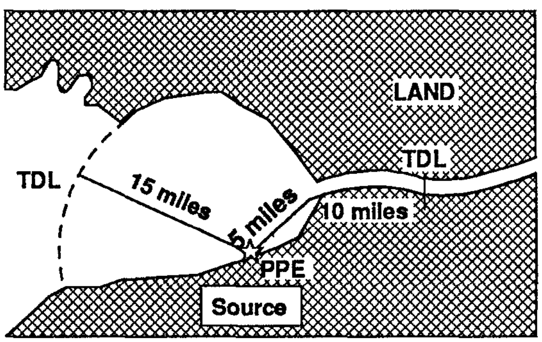
HIGHLIGHT 8-7
DETERMINING TARGET DISTANCE LIMIT

For a river, the TDL is 15 miles downstream from the PPE.



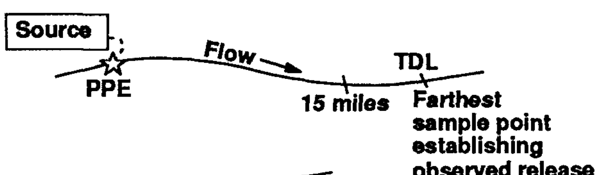
For a lake, ocean, or coastal tidal water, direction of flow is not considered. The TDL is drawn as an arc with radius of 15 miles.



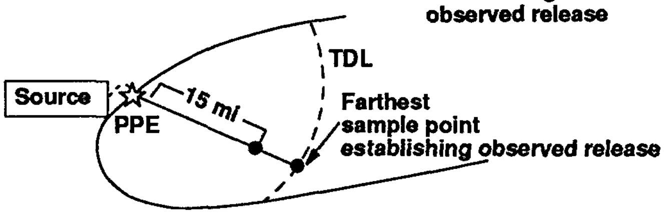


If the TDL for a water body includes both a river/stream and an open water body, the sum of the downstream distance and radius of the arc equals 15 miles.

HIGHLIGHT 8-8
DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH OBSERVED RELEASE BEYOND 15 MILES



When the farthest sample establishing an observed release is more than 15 miles from the PPE, the TDL is extended to this point.



B. SITES WITH MORE THAN ONE PPE

For sites with more than one PPE, define an in-water segment for each PPE, and evaluate targets in each in-water segment of a watershed.

(B1) **Determine the location of each PPE based on delineation of the overland flow segment.**

(B2) **Identify the In-water segment from each PPE.**

(B3) **Determine whether the site is within one watershed.**

- If all of the in-water segments from each PPE do not join within the TDL, consider the site to be in more than one watershed. Evaluate each watershed separately and use the highest score for any watershed as the surface water pathway score for the site (see Section 8.2).

- If all of 8.2 the in-water segments from each PPE join within the TDL, consider the site to be in one watershed and evaluate the in-water segment as follows.

  — If the PPEs for different sources are in the same water body and are relatively close together, determine a single PPE. Evaluate the TDL as described for a single PPE.

  — If hazardous substances from different sources enter the same water body at distant points, the target distance is the distance from the most upstream PPE to 15 miles downstream from the most downstream PPE (or the combined overlapping arcs for two or more PPEs into a lake, coastal tidal water, or ocean). This may result in an overall TDL of greater than 15 miles (see ***Highlights 8-9*** and ***8-10***). The downstream PPE must be within the TDL of the upstream PPE. If this is not true, each PPE is considered to be in a separate watershed and each watershed is scored separately.

  — If the PPEs for different sources are in two different water bodies (e.g., two rivers, two lakes) that later merge into one water body, determine the target distance from each PPE for each source. Total targets are the sum of each segment for each water body. Count targets common to more than one source only once (see ***Highlights 8-11*** and ***8-12***). The merge point should be within the TDL of each PPE; otherwise the sources are considered to be in two or more watersheds.

C. SITES WHERE THE IN-WATER SEGMENT BRANCHES

(C1) **Measure the TDL separately for each branch.**

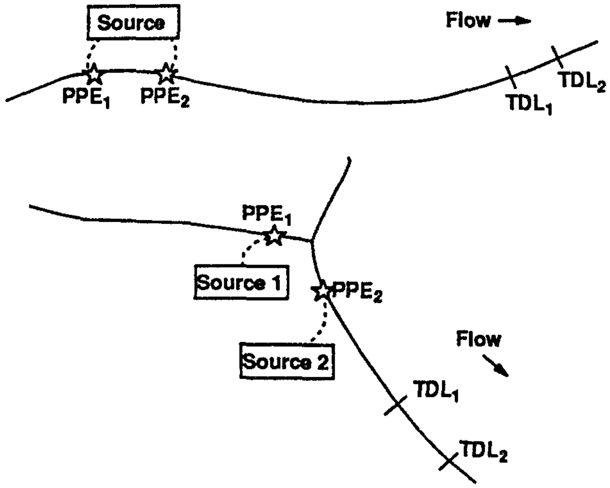
(C2) **Determine If the branches join within the TDL.**

- If the branches do not rejoin within the TDL, determine the TDL in each branch separately (see ***Highlight 8-13***).

- If the branches rejoin within the TDL, determine the TDL within each branch and select the one that is farthest downstream (see ***Highlight 8-13***).

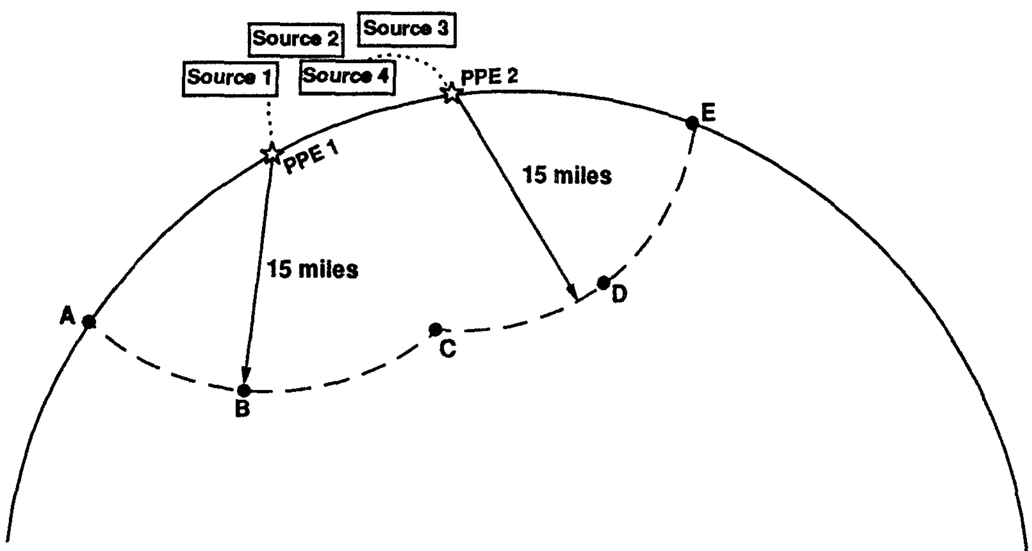
(C3) **Score only those surface water targets that are located partially or wholly within, or contiguous to, the TDL.** Targets in all branches (see ***Highlight 8-13***) are considered when evaluating the watershed.

HIGHLIGHT 8-9
DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH MORE THAN ONE PROBABLE POINT OF ENTRY INTO RIVERS



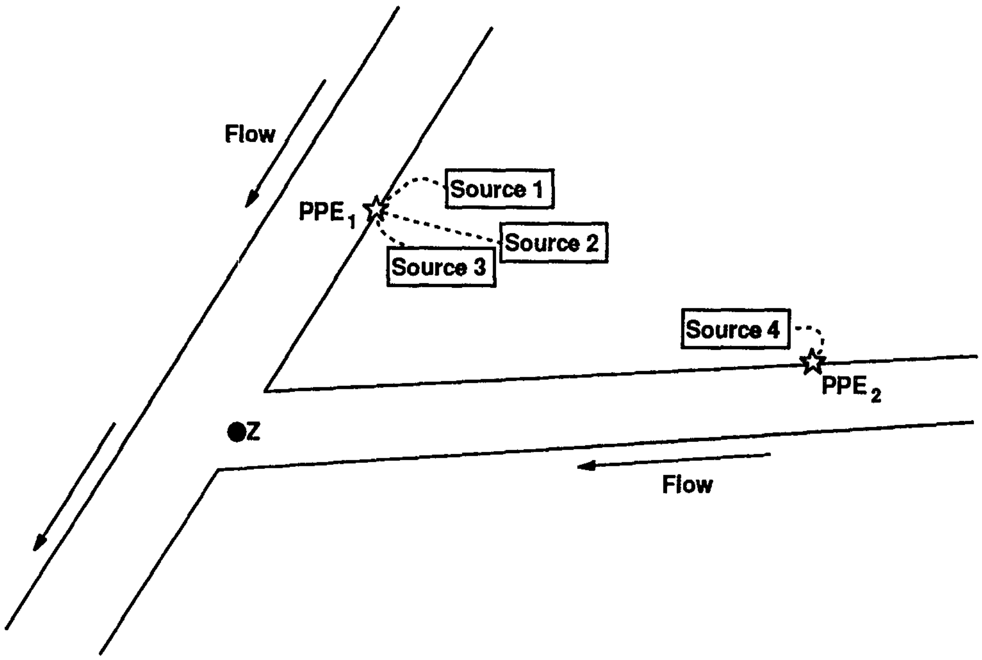
When a site has more than one PPE and the in-water segments join within the TDL, the in-water segment for evaluating the site extends from the most upstream PPE (PPE_1) to the most downstream TDL (TDL_2). The length of the in-water segment in this case may be longer than 15 miles, regardless of whether actual contamination is documented. In both illustrated cases, use TDL_2 as the TDL for the site.

HIGHLIGHT 8-10
DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH MORE THAN ONE PROBABLE POINT OF ENTRY INTO LAKES



- Determine the TDL from PPE_1, the PPE to the lake for Source 1.
- Determine the TDL from PPE_2, the PPE to the lake for Sources 2, 3, and 4.
- Determine the aggregate TDL. In this example, it is the shape formed by arc ABC and arc CDE.
- If the TDLs do not intersect, the water bodies are considered separate watersheds and each watershed is evaluated separately.

HIGHLIGHT 8-11
DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH PROBABLE POINTS OF ENTRY INTO TWO BRANCHES OF A RIVER



- The PPE for Source 4 (PPE_2) is in a different water body than the PPE for Sources 1, 2, and 3 (PPE_1).

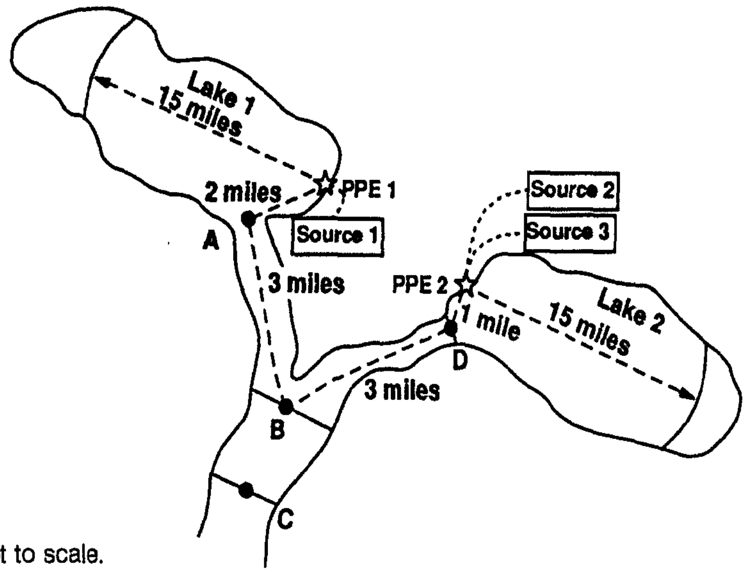
- To determine the target distance, include all of the following:

  – The distance from PPE_1 to Point Z, the juncture of the two water bodies;
  – The distance from PPE_2 to Point Z; and
  – The distance from Point Z to a point 15 miles minus the distance (Z - PPE_1) or 15 miles minus the distance (Z - PPE_2), whichever is greater.

- Consider all waters with PPEs when calculating the total target population values. In this example, consider segment PPE_1 - Z, segment PPE_2 - Z, and segment Z - end of TDL when determining the target populations.

- If the distance from either PPE_1 to Point Z or PPE_2 to Point Z is greater than 15 miles, this example should be scored as two separate watersheds.

HIGHLIGHT 8-12
DETERMINING TARGET DISTANCE LIMIT FOR SITES WITH PROBABLE POINTS OF ENTRY INTO TWO LAKES



NOTE: Graphic not to scale.

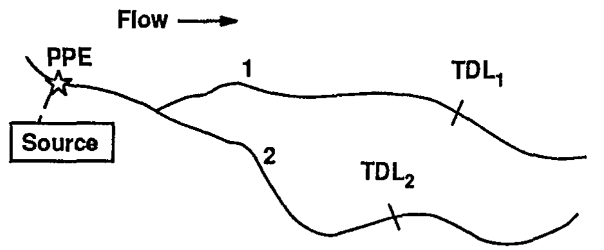
- In this example, the site has probable points of entry into two lakes (PPE_1 and PPE_2) with outflow to the same river. In this situation, the lakes should be considered in the same watershed because their in-water segments meet within 15 miles.

- Measure the TDL in each lake. Also, measure the distance from the PPE to the point of outflow to the river.

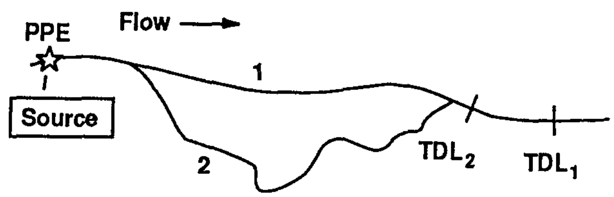
- In this example, the TDLs would be:

  - The 15-mile target distance in each lake;
  - The river segments from the lake outfall to the point the outfalls from each lake meet, A-B and D-B; and
  - The 11-mile distance from point B to point C, which is 15 miles from the PPE for Lake 2. This distance is used because it is farther downstream than the TDL for the PPE into Lake 1 (which would end 1 mile upstream of point C).

HIGHLIGHT 8-13
DETERMINING TARGET DISTANCE LIMIT WHEN THE IN-WATER SEGMENT BRANCHES



If the branches do not rejoin within the TDL, mark the TDL in each branch independently. Count targets in each branch.



If the branches rejoin within the TDL, determine the TDL for each branch and select the one that is farthest downstream. Count targets in each branch and in the combined portions.

D. SITES CONSISTING SOLELY OF CONTAMINATED SEDIMENTS WITH NO IDENTIFIED SOURCE

(D1) **Determine if the surface water body containing the contaminated sediments has a clearly defined direction of flow.**

- If there is a clearly defined direction of flow, proceed to Step (D2).
- If there is no clearly defined direction of flow, proceed to Step (D4).

(D2) **When there is a clearly defined direction of flow, begin measuring the TDL from the farthest upstream sediment sampling point that meets the criteria for an observed release.**

(D3) **Use the sediment sampling point Identified in Step (D2) in lieu of the PPE.**

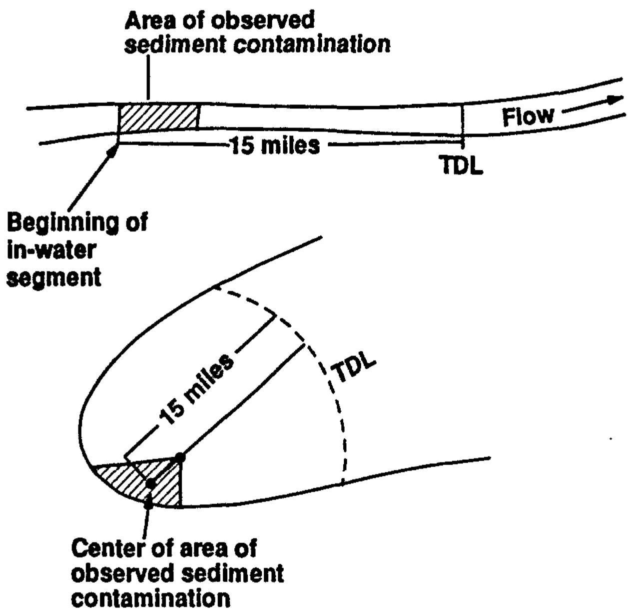
- Follow Steps (A2) and (A3) for sites with a single PPE to determine the TDL.
- Skip Steps (D4), (D5), and (136) below.

(D4) **When there is no clearly defined direction of flow, begin measuring the TDL at the center of the area of observed sediment contamination.** Determine the center using only those sediment sampling points that meet the criteria for an observed release.

(D5) Extend the TDL as an arc with a radius extending either 15 miles along the surface water, or to the most distant sample point that meets the observed release criteria to surface water, whichever is greater. See ***Highlight 8-14*** for an example of determining the TDL in this case.

(D6) Score only those surface water targets that are located partially or wholly within, or contiguous to, the TDL.

HIGHLIGHT 8-14
DETERMINING TARGET DISTANCE LIMIT FOR SITES CONSISTING SOLELY OF CONTAMINATED SEDIMENTS



Clearly Defined Flow Direction:
Use the most upstream sediment sampling point that meets the observed release criteria as the beginning of the in-water segment. TDL is 15 miles downstream from this point.

No Clearly Defined Flow Direction:
Use the center of the area of observed sediment contamination as the beginning of the in-water segment. Draw the 15-mile arc for the TDL from this point.

EVALUATING THE TARGET DISTANCE LIMIT FOR TIDALLY INFLUENCED WATER BODIES

In tidally influenced water bodies, the TDL may extend upstream from the PPE of hazardous substances. Evaluate the downstream TDL for such water bodies in the same manner as for other surface water bodies. The following procedures describe how to establish the upstream TDL for tidally influenced water bodies.

(1) **Because the evaluation of tidal Influence Is complex, determine If there are any significant upstream targets (e.g., sensitive environments, wetlands, fisheries).**

- If there are no significant upstream targets, do not evaluate the effect of tidal influence on the TDL.
- If there are significant upstream targets, proceed to Step (2).

(2) **Document how far upstream the tide can carry hazardous substances.** Use existing documentation on the upstream point of flow reversal, extent of brackish water, or salt water intrusion data. Such documentation is often available from local water authorities. Often, these data can be obtained from appropriate state agencies such as water resource commissions.

(3) **Locate the farthest upstream sample establishing an observed release.**

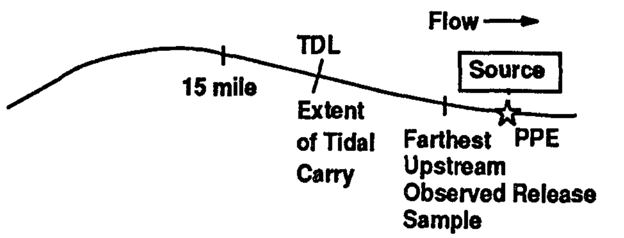
(4) **Determine the upstream boundary of the TDL.** The upstream boundary of the TDL depends on the extent of tidal carry and the farthest upstream observed release sample.***Highlight 8-15*** illustrates these considerations.

- If the farthest upstream sampling point establishing an observed release is located greater than 15 miles from the PPE, use the location of that sampling point as the upstream boundary of the TDL.

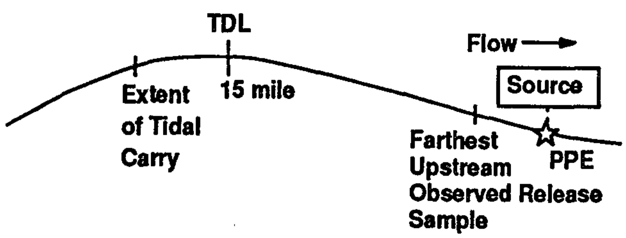
- If the tidal influence is at least 15 miles upstream from the PPE, use 15 miles upstream from the PPE as the upstream boundary of the TDL.

- If the tidal influence is less than 15 miles upstream from the PPE, use the documented distance to which the tide could carry hazardous substances as the upstream boundary of the TDL.

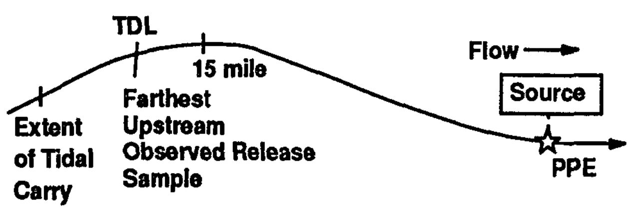
HIGHLIGHT 8-15
DETERMINING UPSTREAM TARGET DISTANCE LIMIT FOR TIDALLY INFLUENCED RIVERS



Upstream TDL is the documented point to which the tide can carry the hazardous substance, because this is less than 15 miles from the PPE.



Upstream TDL is 15 miles from the PPE, because the documented point to which the tide can carry hazardous substances is greater than 15 miles from the PPE.



Upstream boundary of TDL is location of the farthest upstream sampling point establishing an observed release, because this point is greater than 15 miles from the PPE.

TIPS AND REMINDERS

- Consider a perennially flowing irrigation ditch as part of the in-water segment of the hazardous substance migration path.

- If there is no HRS-defined surface water body within 2 miles of the site, do not evaluate the surface water pathway, unless there is an observed release to surface water from the site or the site is in a 500-year (or less) floodplain of the nearest surface water.

- Intermittent rivers in areas with 20 or more inches mean annual precipitation and intermittent lakes (regardless of annual precipitation) are not evaluated as surface water bodies for HRS purposes.

SECTION 8.2 DELINEATION OF WATERSHEDS AND DRAINAGE AREAS

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This section provides guidance on the determination of watersheds, drainage areas and their boundaries, and discusses the use of watershed and drainage area evaluations within the HRS. A watershed is the area drained by, or contributing water to, a surface water body. If the sources at a site are in more than one watershed, each watershed is evaluated separately, and the highest score for any watershed is assigned as the surface water pathway score. The portion of a watershed upgradient from the sources at the site is delineated to determine a drainage area category, which is used to score the runoff factor for potential to release.

RELEVANT HRS SECTIONS

Section 4.0.2	Surface water categories
Section 4.1.1.1	Definition of the hazardous substance migration path for overland flow/flood migration component
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.2.1.2	Runoff

DEFINITIONS

Direction of Overland Flow: Determined on a topographic map by drawing flow lines perpendicular to contour lines. Direction of flow will normally be along these flow lines, from areas of higher elevation toward areas of lower elevation but can be affected by man-made barriers such as walls and sewers. The determination of flow direction is important for identifying the drainage area upgradient of sources at the site and for identifying the overland segment of the hazardous substance migration path.

Drainage Area: The area upgradient of sources contributing water to the sources via overland flow; this area is based on topography, except where overland flow is captured and/or diverted (e.g., storm sewers, run-on control features, walls) around the source. In cases where upland flow is captured or diverted, only the area of the source and areas upgradient of the source between the source and the device or structure diverting overland flow from the source are included in the drainage area.

Hazardous Substance Migration Path: The path that hazardous substances travel or would travel over land from a source to surface water (overland segment) and within surface water to the TDL (in-water segment). In certain cases (e.g., sites consisting only of contaminated sediments, sites where sources are located in surface water bodies), the hazardous substance migration path consists of only an in-water segment.

In-water Segment: Portion of the hazardous substance migration path from the PPE to the TDL. For tidally influenced rivers, the in-water segment may include portions of surface water bodies upstream from the PPE to the extent that the in-water migration path is reversed by tides. For contaminated sediments with no identified source, the in-water segment begins at the upstream boundary (for streams and rivers) or center (for water bodies with no direction of flow) of the area of contaminated sediments.

Overland Segment: Portion of the hazardous substance migration path from a source to a surface water body .

Probable Point of Entry (PPE): Point at which the overland segment of a hazardous substance migration path intersects with surface water. A site may have multiple PPEs. The PPE is assigned as the point at which entry of the hazardous substances to surface water is most likely.

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Watershed: Portion of the watershed downgradient of sources at the site. The watershed includes the surface water bodies between the PPEs and the TDL (i.e., the in-water segment of the hazardous substance migration path). A single watershed includes all in-water segments that intersect within the TDL. A site is in two or more watersheds if two or more hazardous substance migration paths from the sources do not reach a common point within the TDL. In these cases, each distinct watershed is evaluated separately.

DELINEATING WATERSHEDS

The key to evaluating watersheds is to first identify the hazardous substance migration paths (see Section 8.1). Most sites are in a single watershed. However, multiple watersheds may be identified for larger sites. Where multiple watersheds occur, evaluate each watershed separately.

(1) **Compile maps that show the sources being evaluated and all surface water bodies within the TDL.**

- Locate all sources on a map.

- Examine topography and surface water bodies around the site to identify PPEs (if this is not possible, use a straight line distance between sources at the site and surface water bodies to estimate locations of PPEs).

- Compile sufficient maps to evaluate 15 miles radially or downstream of all PPEs, as appropriate. Additional maps may be needed as the hazardous substance migration path is refined to reflect precise locations of PPE's, TDLs within a water body, and tidal influences.

(2) **Identify the overland segment from each source to all surface water bodies within 2 miles of the source.** Identify all other routes of migration to surface water, such as flooding. (Remember, for surface water migration by flooding, sources in a 500-year or less floodplain do not need to be within 2 miles of a surface water body.)

- Each source may have multiple overland segments to a single surface water body or to different surface water bodies, establishing multiple PPEs. These PPEs may or may not differ for sources.

- Locate each overland segment and associated PPE on the maps. The overland segment may not be able to be determined solely from a topographic map. Supplement the maps with field observations, if needed, to determine the presence of man-made impediments.

- Locate all other PPEs due to flooding or observed releases by direct observation to surface water.

(3) **For each PPE, draw the In-water segment of the hazardous substance migration path to the TDL.**

(4) **All hazardous substance migration paths with in-water segments that intersect within the TDL are considered to be In the same watershed for scoring purposes.**

- Targets for a watershed are evaluated along all portions of the hazardous substance migration paths comprising the watershed.

- All sources with PPEs in a watershed are assigned to that watershed for scoring purposes. A source can be assigned to more than one watershed.

Highlight 8-16 provides an example of delineating a single watershed.***Highlight 8-17*** provides an example of evaluating multiple watersheds.

DETERMINING DRAINAGE AREA

Drainage area includes both the area of the sources and the areas upgradient of sources that can contribute runoff to the sources. Drainage area is evaluated under potential to release via overland flow and is evaluated separately for each watershed. It is not necessary to evaluate drainage area if an observed release has been established.

HRS Table 4-3 provides factor values assigned to drainage areas. As shown in that table, drainage area is evaluated within broad ranges, with ranges between 50, 250, and 1,000 acres. The level of precision required for drainage area calculations should be consistent with the need to identify the appropriate range.

Both the area of sources for each watershed and the areas upgradient of these sources can be readily estimated from USGS topographic maps. Observations from the SI may be critical for identifying runoff control or diversion structures (e.g., storm drains) that may not appear on topographic maps.

(1) **Determine the area (or portion of the area) of each source applicable for the watershed being evaluated.** Information may be available from hazardous waste quantity evaluations.

- If source dimensions are known from site visits or other information, use this to determine area.

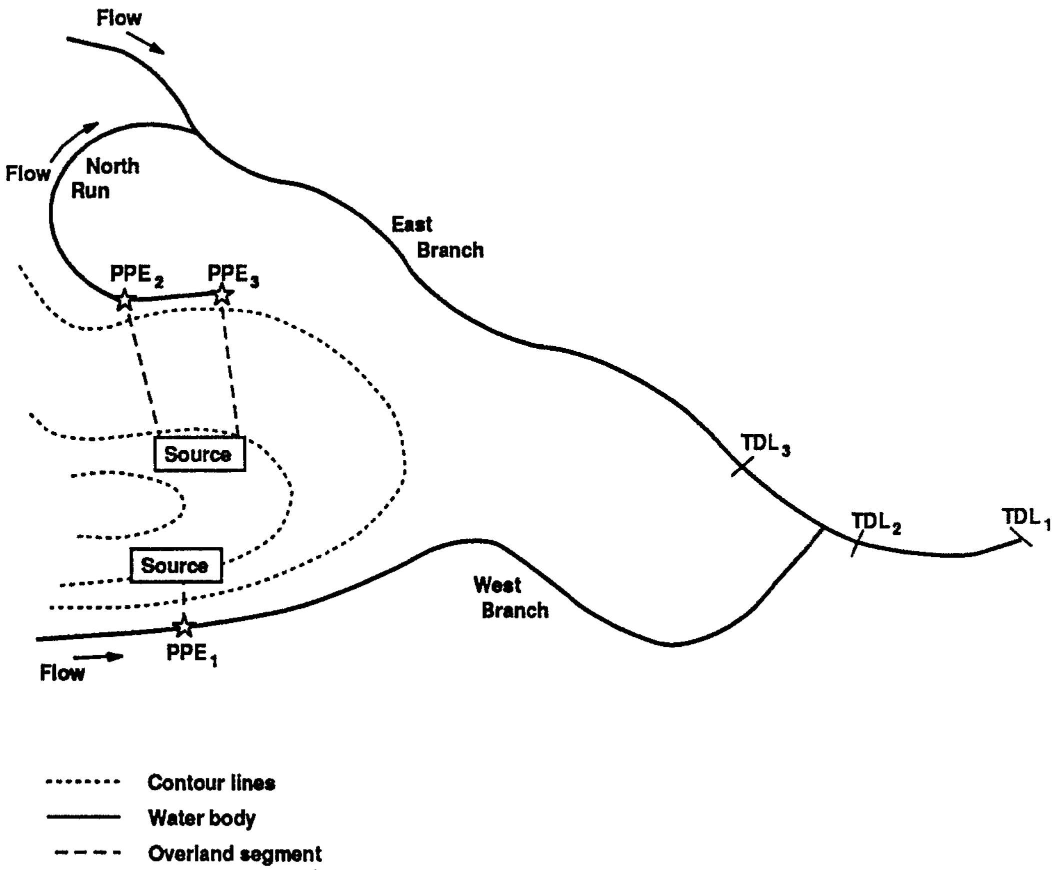
- If source dimensions are not known, locate each source on a topographic map and approximate dimensions using the map scale.

(2) **Determine the area upgradient of each source.**

- Identify structures or features that prevent the flow of runoff onto, across, and/or off sources at the site; field observations should identify locations of such structures.

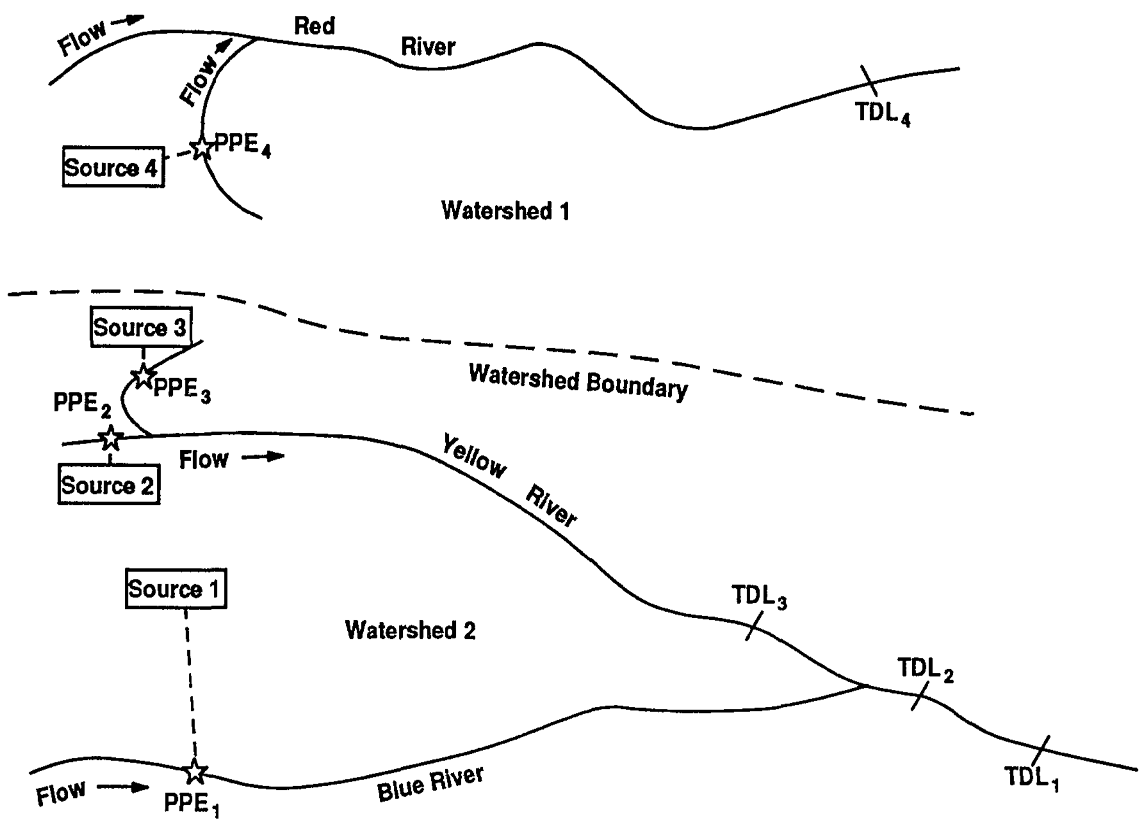
- Determine upgradient areas based on a topographic map (or other representations of elevation data).

HIGHLIGHT 8-16
DEFINING A SINGLE WATERSHED WITH MULTIPLE PROBABLE POINTS OF ENTRY



- In this example, two sources are located along a topographic high.
- Establish all PPEs for each source.
- Determine the TDLs from each PPE:
  - The TDL from PPE_1 ends farthest downstream, past the confluence of the East and West Branches (TDL_1).
  - The TDL from PPE_2 ends just past the confluence of the East and West Branches (TDL_2).
  - The TDL from PPE_3 ends on the East Branch (TDL_3).
- Since the hazardous substance migration paths for both sources overlap within the TDL, evaluate the in-water segments of North Run, East Branch, and West Branch as a single watershed, using TDL_1 as the TDL for the site.

HIGHLIGHT 8-17
DEFINING MULTIPLE WATERSHEDS



- In this example, four sources are located at a single site.
- Establish PPEs for each source.
- Determine the in-water segment for each PPE.
- The hazardous substance migration paths for Sources 1, 2, and 3 overlap to establish one watershed.
- The hazardous substance migration path for Source 4 does not overlap with any others; a second watershed is established.
- Sources 1, 2, and 3 are assigned to Watershed 2 for scoring purposes and Source 4 is assigned to Watershed 1.
- If the hazardous substance migration path for Source 2 did not reach Blue River (TDL_2), three watersheds would be scored – Source 1 with a PPE into Blue River, Sources 2 and 3 with PPEs into Yellow River, and Source 4 with a PPE into Red River.

- Outline the areas upgradient of each source, as follows:

  — Draw flow lines on the topographic maps, perpendicular to the contour lines.

  — Place arrows on the flow lines in the direction of decreasing elevation.

  — For flow lines that intersect sources, extend the flow lines in the upgradient direction (i.e., direction of increasing elevation) until one of the following is reached:

    -- A structure or feature that prevents runoff from crossing the source (e.g., railroad track, wall, road); or

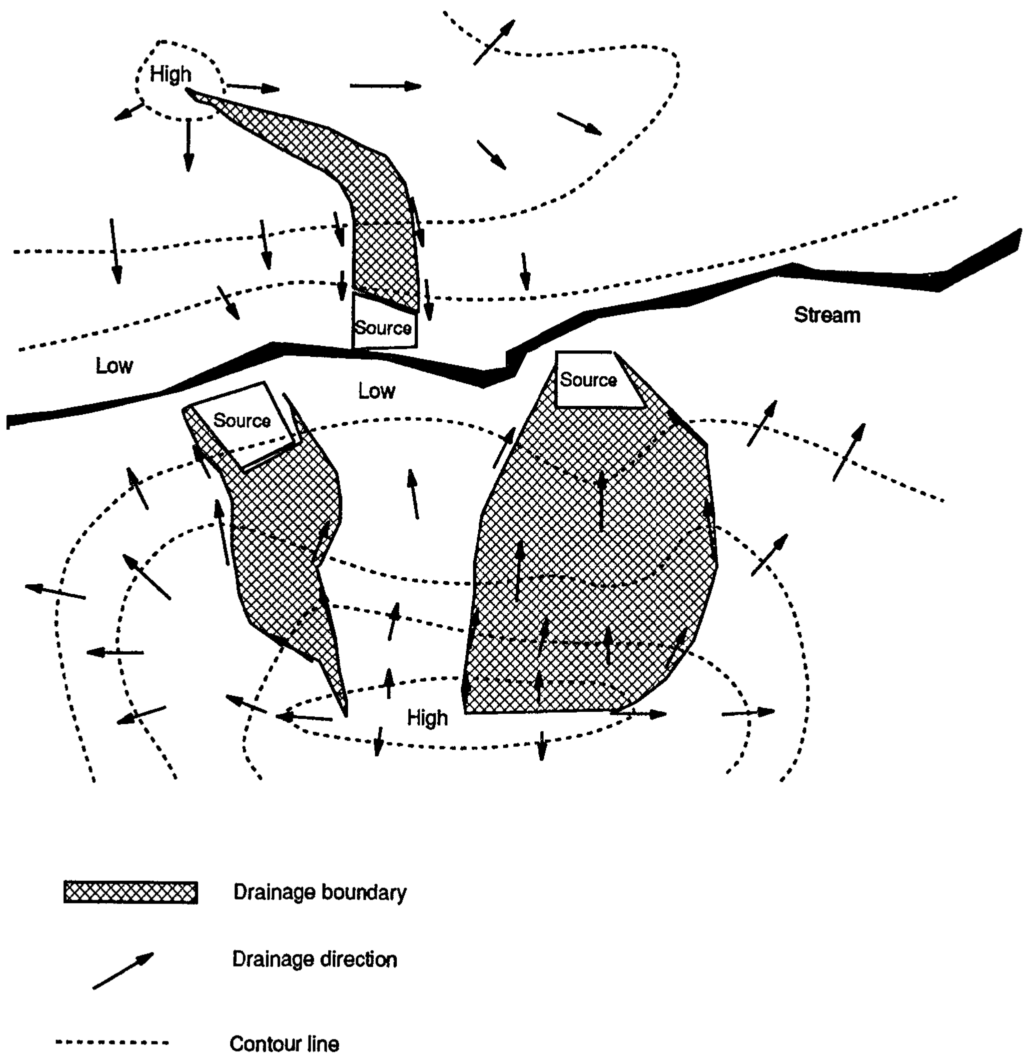
    -- An area where elevation ceases to increase.

  — Draw an outline around the areas contained by flow lines that intersect a source and meet the criteria outlined above.

- Calculate the area within the outline of the drainage area using the scale of the topographic map.

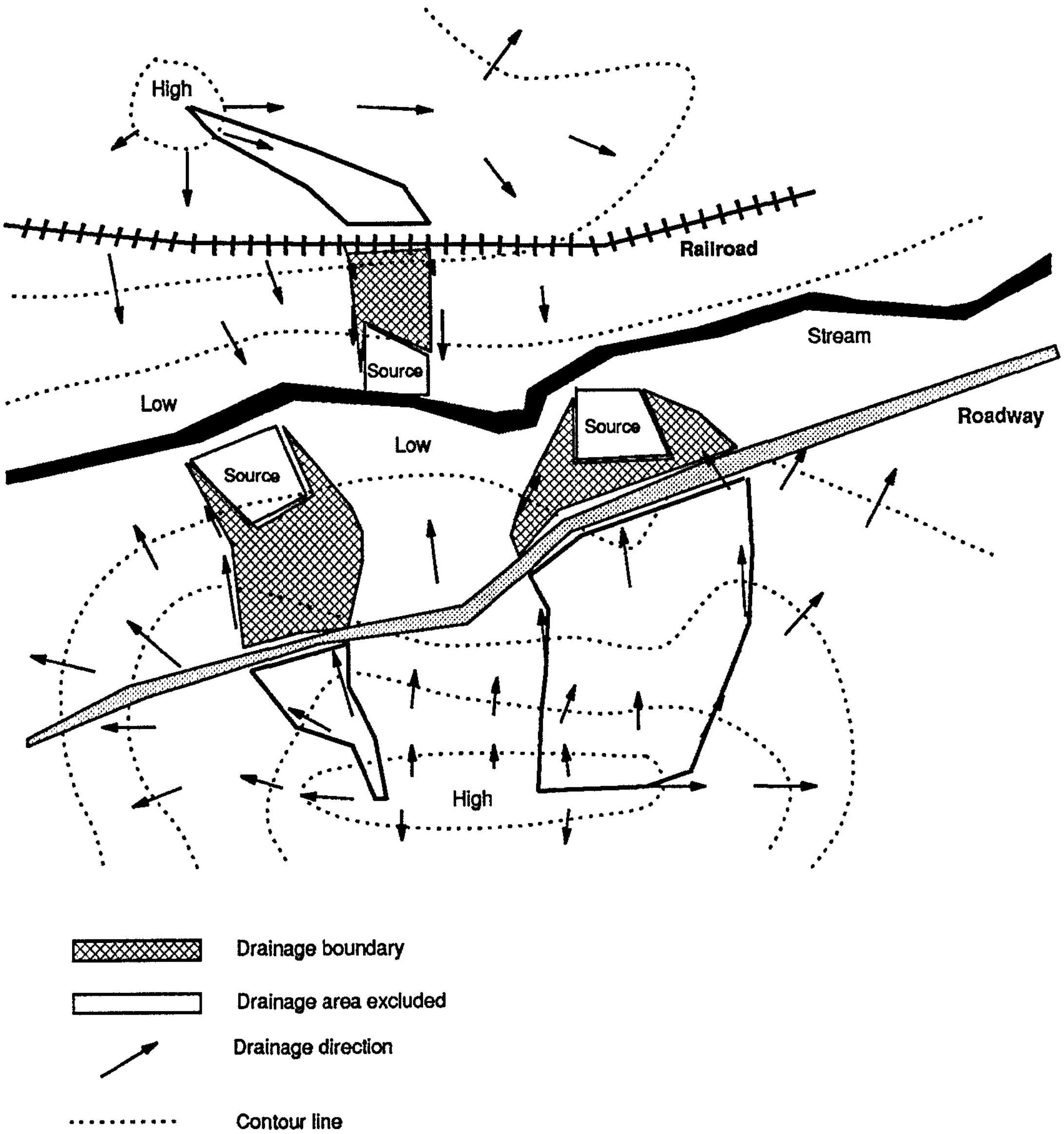
Highlights 8-18 and ***8-19*** provide examples of determining drainage area.

HIGHLIGHT 8-18
DRAINAGE AREA DETERMINATION



- Draw flow lines perpendicular to the nearest upgradient contour line from the edges of each source.
- Extend the flow lines between contour lines in the upgradient direction until a topographic high is encountered (a closed ring on a topographic map).
- Close off the drainage area at the topographic high.
  - For circular topographic highs, use the center of the area enclosed by the highest contour line as the highest point of elevation.
  - For elongated topographic highs, draw a ridge line along the center of the length of the area enclosed by the highest contour line to represent the highest points of elevation.

HIGHLIGHT 8-19
DRAINAGE AREA RESTRICTED BY MAN-MADE STRUCTURES



- Draw flow lines perpendicular to the nearest upgradient contour line from the edges of each source.
- Extend the flow lines between contour lines in the upgradient direction until a topographic high is encountered (a closed ring on a topographic map).
- A roadway and railroad tracks are located on opposite sides of the surface water body.
- The roadway and railroad tracks are upgradient of the sites and are considered to divert runoff from the sites.
- Boundaries of the drainage area do not extend beyond the railroad tracks or roadway.

TIPS AND REMINDERS

- Score each watershed separately within the surface water migration pathway. Use the watershed with the highest score as the pathway score for the site.

- Establish a single watershed for all hazardous substance migration paths whose in-water segments intersect within the TDL..

- An isolated body of surface water (e.g., small lake or pond) is evaluated as a separate watershed. In an area with several isolated ponds, wetlands, lakes, or quarries, consider each to be a separate watershed.

- Evaluate drainage area at the level of detail needed to identify the appropriate factor value range, which has breakpoints defined at 50, 250, and 1,000 acres. Often the measure or estimate of drainage area does not need to be very precise because of these ranges.

- Drainage area boundaries are important for evaluating the soil group factor, which considers the predominant soil group within the drainage area boundaries.

SECTION 8.3
CHARACTERIZATION OF SURFACE WATER BODIES

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This section explains how to characterize several aspects of surface water for the purpose of evaluating the surface water pathway. Specifically, this section explains how to determine the surface water body category, how to determine the salinity category of surface water, and how to evaluate targets in multiple water body categories. The surface water body category is important for determining TDLs, dilution weights, and persistence factors. Salinity categories are important for selecting bioaccumulation potential and ecosystem bioaccumulation potential factor values, ecosystem toxicity values, and ecological-based benchmarks.

RELEVANT HRS SECTION

Section 4.0.2	Surface water categories
Section 4.1.2.3.1	Nearest intake
Section 4.1.3.2.1.3	Bioaccumulation potential
Section 4.1.4.2.1.1	Ecosystem toxicity
Section 4.1.4.2.1.3	Ecosystem bioaccumulation potential
Section 4.1.4.3.1	Sensitive environments

DEFINITIONS

Bioaccumulation Potential: Evaluates the tendency for a substance to accumulate in the tissue of an aquatic human food chain organism and forms one component of the toxicity/persistence/bioaccumulation and toxicity/mobility/persistence/bioaccumulation factors within the human food chain threat-waste characteristics factor category.

Brackish Water: Water with an average tidal cycle chloride concentration of greater than 250 mg/l but less than 18,700 mg/l (corresponding to salinity of greater than 0.45 but less than 34 parts per thousand).

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination based on the flow or depth of the water body at the target.

Ecosystem Bioaccumulation Potential: Evaluates the tendency for a substance to accumulate in the tissue of any aquatic organism, not just human food chain organisms (as in bioaccumulation potential), and forms one component of the ecosystem toxicity/persistence/bioaccumulation and ecosystem toxicity/mobility/persistence/bioaccumulation factors within the environmental threat-waste characteristics factor category. HRS Table 4-15 and sections 4.1.3.2.1.3 and 4.1.4.2.1.3 provide the data hierarchy to follow when evaluating bioaccumulation potential.

Ecosystem Toxicity: The toxicity of a substance to aquatic organisms. It forms one component of the ecosystem toxicity/persistence/bioaccumulation and ecosystem toxicity/mobility/persistence/bioaccumulation factors within the environmental threat-waste characteristics factor category. HRS Table 4-19 provides the data hierarchy to follow when evaluating ecosystem toxicity.

Flow: The long-term average annual discharge of a river or stream (i.e., the annual discharge averaged over many years of record).

Fresh Water: Water with an average tidal cycle chloride concentration of 250 mg/l or less (corresponding to salinity of 0.45 parts per thousand or less).

Salt Water: Water with an average tidal cycle chloride concentration of 18,700 mg/l or greater (corresponding to salinity of 34 parts per thousand or greater).

DETERMINING BREAKPOINTS BETWEEN SURFACE WATER CATEGORIES

Determining the breakpoint between surface water categories is the first step in identifying the water body type in which a target is located. If targets clearly are located within a particular category, it generally is sufficient to approximate these breakpoints (e.g., by drawing lines on a scale map or diagram). When targets are located close to a breakpoint, determine the breakpoints with greater precision, as follows.

(1) **Determine the breakpoint between rivers and coastal tidal waters.** The mouths of rivers are the breakpoints between rivers and coastal tidal waters. Estuarine portions of rivers affected by tidal waters are classified as rivers under the HRS. The presence of tidal water is not a criterion for separating rivers from coastal tidal waters. Identify the mouths of rivers using the following sources.

- Contact the appropriate river basin commission, state or local planning commission, district office of the U.S. Army Corps of Engineers, or the state or district office of the USGS Water Resources Division to identify the river mouth. For many areas, river mouths have been established through intergovernmental processes and legal definition.

- Refer to river reach data bases (e.g., STORET) to determine river mile 0 for the river in question. This can be used as a surrogate for the river mouth.

- Manually draw the river mouth from headland to headland (e.g., the mouth of the Potomac River is drawn from Point Lookout, MD to Smith Point, VA). Where headlands, points, or other topographic features are not identifiable, delineate the mouth of the river so as not to depart from the general direction of the shoreline of the coastal tidal water body into which the river flows. In general, the area of the river lying within the line should be subject to the net seaward flow.

(2) **Determine the breakpoint between coastal tidal waters and the ocean.** The baseline of the Territorial Sea is the breakpoint between coastal tidal waters and the ocean. Consider the following to identify the baseline of the Territorial Sea.

- The baseline of the Territorial Sea is indicated on some nautical maps, especially when local intergovernmental agreements have established an unusual baseline configuration.

- If the baseline of the Territorial Sea is not indicated on available charts, determine the baseline from maritime boundaries (3, 9, or 12 nautical mile lines) shown on conventional nautical coast charts prepared by the National Oceans Service, or similar coastal maps.

— Measure back toward the shoreline from the maritime boundaries nearest to the shore shown on the available charts. See ***Highlight 8-20.***

— On December 27, 1988, the maritime boundary was moved from 3 miles to 12 miles from the baseline of the Territorial Sea. Therefore, measure back either 3 or 12 nautical miles from the maritime boundary, depending on the date of the nautical chart.

— The maritime boundary is 3 leagues from the baseline of the Territorial Sea in the Texas and Florida Gulf Coasts and in Puerto Rico.

— A maritime boundary may meander as it aligns with offshore sandbars or other features. In such cases, waters located offshore, but shoreward of a sandbar, are classified as coastal tidal waters for HRS purposes.

(3) **Determine the breakpoints between lakes and rivers**. The heads of rivers leading from a lake or the mouths of rivers entering a lake are the breakpoint between lakes and rivers.

- Breakpoints between rivers and lakes should be determined by looking at maps for obvious areas of in-flow or out-flow.

- A constant elevation across a water surface is indicative of a lake, while a drop in elevation is indicative of a river. This criterion may be used to determine breakpoint between the two.

- If not easily determined (i.e., broad widening of river into lake), approximate the breakpoint as half the distance between the start and end points of the widening.

ASSIGNING SURFACE WATER DILUTION WEIGHTS

Targets subject to potential contamination are evaluated using dilution weights as outlined in HRS Table 4-13. The dilution weight reduces the point value assigned to targets subject to potential contamination as the flow or depth of the surface water body increases. To assign a dilution weight in a river, estimate the flow at targets. For lakes, assign the dilution weight based on flow into or out of the lake. For oceans and the Great Lakes, assign the dilution weight based on depth of the ocean or Great Lake. Dilution weights are assigned based on ranges of flow or depth; precise measurement generally is needed only near a range breakpoint.

(1) **Identify locations where flow must be estimated**.

- For rivers, flow is estimated at locations of targets subject to potential contamination.

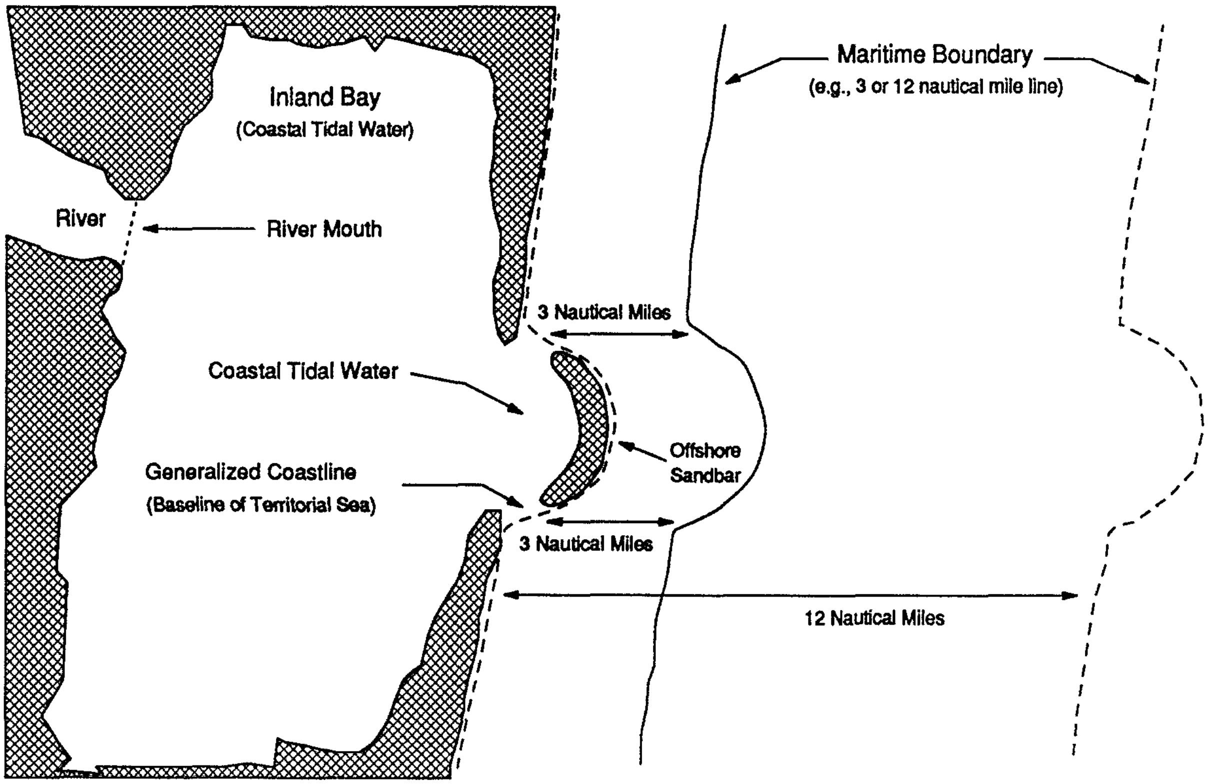
- For lakes, flow is estimated as follows:

  — For a lake with surface water flow entering, assign a dilution weight based on the sum of the average annual flows for the surface water bodies entering the lake, up to the location of the target.

  — For a lake with no surface water flow entering, but that does have surface water flow leaving, assign a dilution weight based on the sum of the average annual flows for the surface water bodies leaving the lake.

  — For a lake with no surface water flow entering or leaving, assign a dilution weight based on the average annual ground water flow into the lake, if available. If not available, assign a default dilution weight of 1.

HIGHLIGHT 8-20
BREAKPOINT BETWEEN COASTAL TIDAL WATERS AND OCEAN



The baseline of the Territorial Sea is the boundary between coastal tidal waters and the ocean. If the baseline of the Territorial Sea is not indicated on a nautical map, determine it as follows:

- Find the maritime boundary on a nautical map.
- Determine whether the boundary is 3 or 12 nautical miles from the baseline of the Territorial Sea, depending on the date of the map. On December 27, 1988, the boundary was moved from 3 to 12 nautical miles from the baseline.
- Measure the appropriate distance (3 or 12 nautical miles) shoreward from the maritime boundary.

(2) **Determine if flow data are available at the locations identified above**. If gauging stations are located near the locations identified in Step (1), assign a dilution weight using average annual discharge or flow data from these stations. ***Highlight 8-21*** lists sources of flow data. When no gauging stations are located near these locations, estimate the average annual discharge or flow for the target as summarized in the subsection below, Estimating Flow.

(3) **Estimate the flow at each location identified in Step (1).** Four methods that can be used to estimate flow are: (1) interpolation of flow data, (2) extrapolation of flow data, (3) estimation of flow using downstream gauging stations, and (4) estimation of flow using the runoff-area method. The level of precision required in determining the flow should be consistent with being able to place the flow at the target in the appropriate range. These methods are detailed below.

HIGHLIGHT 8-21
SOURCES OF FLOW DATA

Primary Source

- *The Water Resources Data Annual Report,* published for each state by USGS. This Report lists varous water quality and quantity parameters for each gauging station in the USGS network for the water year (October 1 - September 30)

Secondary Sources

- National Water Data Exchange (NAWDEX) data base, maintained and admisistered by USGS Headquarters in Reston, VA, or NAWDEX Assistance Centers at the Water Resources Division district offices can help acquire data.
- EPA Regional STORET data.
- *Average Annual Runoff in the United States, 1951-80*, published by USGS.
- *Map of the Mean Annual Runoff for the Northeastern, Southwestern, and Mid-Atlantic United States, Water Years 1951-80,* published by USGS.

Other Possible Sources

- Federal Agencies

  USGS
  Army Corps of Engineers
  National Weather Service
  Forest Service
  Soil Conservation Service (SCS)
  Bureau of Land Management
  Bureau of Reclamation
  Bonneville Power Administration
  Tennessee Valley Authority

- Canadian Agencies

  Inland Water Directorate, Water Resources Branch

- State Agencies

  Departments of Water Resources
  Departments of Natural Resources
  Departments of Environmental Protection
  Water Control Boards

- River Basin Commissions

  Susquehanna River Basin Commission
  Upper Colorado River Basin Commission

- Non-profit Organizations

  Alliance for the Chesapeake Bay

- Local Agencies and Organizations

  Departments of Health
  Municipal Water Authorities
  Electric Power Utilities

(4) **If applicable, evaluate short-term streamflow information**. Estimating streamflow information is described in ***Highlight 8-22***.

(5) **Use estimate of flow to assign dilution weight to targets**. Use HRS Table 4-13 to assign a dilution weight.

ESTIMATING FLOW

When estimating flow, first identify where gauging stations are located and determine which methods are appropriate. In many instances, no gauging stations will be located near a target or within the TDL, but one or more gauging stations may be found some distance upstream or downstream from the target. In these cases, it may be possible to use interpolation or extrapolation to

HIGHLIGHT 8-22
EXTENDING SHORT-TERM STREAMFLOW RECORDS

In some cases, short-term streamflow Information maybe available for fewer than five complete water years as required by the USGS for calculating "average because the years of record may have been unusually wet or dry and the mean may be skewed accordingly. A better approach Is to compare the mean flow calculated to a nearby gauging station which has a long-term data record. A ratio (DR_{AB}) is calculated between the mean flow at the short-term station (Q_A) and the mean flow at the long-term station (Q_B) for the same years. The ratio Is then multiplied times the discharge from the long-term gauging station for all years as follows:

		Discharge (cfs)	
A.	Available Data Water Year	Station A (Short-term)	Station B (Long-term)
	1989	94	188
	1988	85	176
	1987	95	195
	1986	--	219
	1985	--	233
	1984	--	220
	Means for period of record;	91	205
	Means for 87-89	91	186

B. Calculate ratio between mean discharges for Station A and Station B for the same period of record (87-89):

$$DR_{AB} = Q_A / Q_B = 91 \text{ cfs} / 186 \text{ cfs} = 0.49$$

D. Estimate the long-term corrected annual discharge at Station A using discharge ratio and data from Station B:

$$Q_{A\,(84\text{-}89\text{ Est.})} = Q_{B\,(84\text{-}89)} \text{x} DR_{AB} = 205 \text{ cfs x } 0.49 = 100 \text{ cfs}$$

estimate the flow at the target. In other cases, it may not be possible to interpolate or extrapolate, but it may possible to estimate the flow using downstream gauging stations or by the runoff-area method.

When interpolating or extrapolating, follow these guidelines:

- Rivers or streams should have flows greater than 100 cfs when interpolating, and greater than 1,000 cfs when extrapolating.
- There should be no significant inflows from tributaries relative to the discharge in the main branch.
- Watershed should be fairly uniform in character and not be in an and or semi-arid region.
- No major lakes, dams, significant diversions, withdrawals, or other controls should be between the gauging stations and the target areas.
- Area between gauging stations (not necessarily the entire watershed) should not be subject to significant variations in rainfall patterns.

In addition use the following guidelines when extrapolating:

- The gauging station should be as close to the target as possible.

- For downstream targets, the gauged discharge value of the station nearest to the target should be at the low to middle portion of the flow characteristics range listed in HRS Table 4-13; conversely, for upstream targets, the gauged discharge value should be at the middle to high portion of the range.

ESTIMATING FLOW BY INTERPOLATION

When using interpolation to estimate flow at a target, the gauging stations generally should not be located far apart. The maximum acceptable distance will depend on the characteristics of the river or stream, the tributary inflows, and the characteristics of the watershed. For a large river with no inflows equaling a significant percentage of the main flow, it may be possible to interpolate 50 miles or more. For small streams, linear interpolation may only be valid for short distances. ***Highlight 8-23*** provides an example of estimating flow using interpolation.

(1) **Identify two gauging stations**. One gauging station should be upstream (station A) and the other downstream (station B) of the target.

(2) **Using HRS Table 4-13, determine the assigned dilution weight for each gauging station**.

- If the dilution weights are the same for station A and station B, document that the annual discharge values yield the same dilution weight in HRS Table 4-13, and assign that dilution weight to the target.

- If the dilution weights are different, proceed to Step (3).

(3) **Perform linear Interpolation**. In more complex cases, there is a change in the assigned dilution weight from station A to station B. If the size of the river or stream is much larger than the size of any tributary inflows (e.g., a 6^{th} order stream with 1^{st} and 2^{nd} order tributaries) and the watershed between the two stations is uniform (e.g., the tributary inflows are about equal in magnitude and uniformly distributed along the length of the stream segment between the two stations), it may be possible to perform a linear interpolation.

- Determine the incremental discharge. Subtract the average annual discharge of the upstream station, Q_A (in cfs), from the downstream station, Q_B, to determine what is known as the incremental discharge, Q_I.

$$Q_I = Q_B - Q_A$$

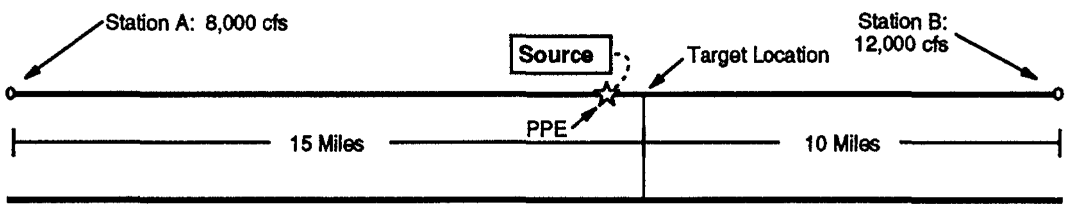
- Calculate a change in discharge per unit length. Divide the incremental discharge by the length of the stream segment from station A to station B, L_{AB} (units of length may be chosen as needed, but use the same units throughout), to yield a change in discharge per unit length, Q_X.

$$Q_X = Q_I / L_{AB}$$

- Calculate the estimated discharge at the target. Multiply the change in discharge per unit length, Qx, times the distance from the upstream station A (in the same units used for L_{AB}) to the target of concern, L_{AT}, and add the result to the discharge at station A, Q_A, to yield the estimated discharge at the target, Q_T(est).

$$Q_T(\text{est.}) = (Q_X \times L_{AT}) + Q_A$$

HIGHLIGHT 8-23
ESTIMATING TARGET FLOW USING INTERPOLATION



A site is located in a mixed use suburban community, in close proximity to a river. The river is subject to potential contamination, and the PPE for hazardous substances has been identified. The river is not subject to tidally influenced waters.

In order to evaluate a target subject to potential contamination, a dilution weight must be assigned to the target. Because there is no gauging station located at or in close proximity to the target, the flow rate at the target must be estimated. Existing conditions (e.g., there are no significant inflows from tributaries relative to the discharge in the main branch) allow for the interpolation method to be used.

(1) **Identify two gauging stations — one upstream (station A) and one downstream (station B) of the target.**

Station A — Q_A = 8,000 cfs
Station B — Q_B = 12,000 cfs

(2) **Using HRS Table 4-13, determine the assigned dilution weight for each gauging station.**

Station A = 0.001
Station B = 0.0001

Because the dilution weights are different, proceed to Step (3).

(3) **Perform linear interpolation.**

- Determine the incremental discharge.
  Q_I = 12,000 cfs - 8,000 cfs = 4,000 cfs

- Calculate a discharge per unit length.
  Q_L = 4,000 cfs / 25 mi = 160 cfs/mi

- Calculate the estimated discharge at the target.
  Q_T(est.) = (160 cfs/mi x 15 mi) + 8,000 cfs = 10,400 cfs

- Using HRS Table 4-13, assign a dilution weight to the target based on the estimated flow for the target, 10,400 cfs. The dilution weight for the target is 0.0001.

ESTIMATING FLOW BY EXTRAPOLATION

If two gauging stations are located either upstream or downstream from the target, an estimate of flow at the target can be obtained by extrapolation, as described below.

(1) **Identify the nearest gauging station upstream or downstream of the target.**

- If this gauging station is located relatively close to a target, assign the dilution weight that corresponds to the gauged flow to the target.

- If this gauging station is located too great a distance from the target to allow confidence in using this method, proceed to Step (2).

(2) **Perform linear extrapolation.** This method may be used in situations where a target is located in a river or stream in which two gauging stations (C and D) are located on a river or stream segment that does not include the target area. The linear extrapolation method uses the linear interpolation calculation described above to estimate a rate of change for the discharge in the segment of the river or stream bounded by stations C and D, and then assumes that the rate of change is constant from the nearest station to the target.

- Identify two gauging stations, both either upstream or downstream of the target.

- Calculate a change in discharge per unit length (Q_X), as discussed for the interpolation method.

- Calculate the estimated discharge at the target. Multiply the change in discharge per unit length, Q_X, times the distance from the target to the nearest gauging station, L_{DT} or L_{CT}, to yield an estimated incremental discharge value.

  — If the target is located downstream from the nearest gauging station, the estimated incremental discharge value is added to the gauged discharge value for the nearest station.

  $$Q_T(\text{est.}) = Q_D + (Q_X \times L_{DT})$$

  — If the target is located upstream from the nearest station, the estimated incremental discharge value is subtracted from the gauged discharge value for the nearest station.

  $$Q_T(\text{est.}) = Q_C - (Q_X \times L_{CT})$$

ESTIMATING FLOW USING ONE DOWNSTREAM GAUGING STATION

In some instances, only one gauging station is present on a river or stream, but at some distance from a target. In these cases, it may be possible to extrapolate the flow data to the target location. However, this technique should be applied only over relatively short distances since there is no way to estimate the rate of change of the discharge between the gauging station and the target.

To use this method, the flow at target locations is set equal to the flow at a downstream gauging station, as long as the flow at the target will not exceed this value. This approach is acceptable because it will not underestimate the actual flow and thus, overestimate target values.

ESTIMATING FLOW FOR UNGAUGED WATERSHEDS

Some rivers or streams may not have gauging stations. To estimate the average flow in an ungauged river or stream, use the runoff-area method described below.

(1) **Draw the watershed boundaries for the point In the stream where the flow Is to be map estimated on the topographic map.** The scale of the map to be used will depend on the size of the watershed to be measured. The 7.5 minute (1:24,000) topographic maps can be used for small watersheds (e.g., less than 25 miles), especially if they fit on one or two adjacent map sheets. For larger watersheds or elongated watersheds spanning several map sheets, a larger scale such as 1:50,000 or 1:100,000 should be used. Maps with scales greater than 1:250,000 should be avoided because the resolution of the topographic lines is too crude to estimate boundaries correctly.

(2) **If there are multiple targets, delineate the additional downstream watershed area for the farthest downstream target area.** If, after advancing through this procedure, it is found that a change in the dilution weighting factor occurs somewhere upstream of the last target, estimate where the transition may occur, delineate the watershed for the point, and then estimate flow at that point. The best place to look for transitions is where a major tributary meets the stream.

(3) **For each watershed delineated, determine the enclosed area** This may be done by any of several methods including using a planimeter, counting squares, weighing paper, or digitizing the boundaries with a CAD or GIS system, The area should be expressed in units of square miles.

(4) **Select gauging stations using the following guidelines.**

- The gauged watersheds should be as close to the ungauged watershed as possible.
- The gauged watersheds should be of a similar character in terms of topography, precipitation, and land use.
- The gauged watersheds should be approximately the same size as the ungauged watershed area.

(5) **Divide the "average flow" value (Q_{gauge}, in cfs) for each selected station by the "drainage area" (A_{gauge}, In mi^2) to derive a flow per unit area parameter, R_{gauge}(In cfs/mi^2).**

$$R_{gauge} = Q_{gauge} / A_{gauge}$$

- If any value varies from the others by more than 25 percent, examine the watershed that it drains and try to determine whether the station is actually representative of the ungauged area.
- Average the R_{gauge} values of the selected stations to yield a regional unit flow value R_{region}.

  Another procedure to obtain R_{region} is to use average annual runoff maps, such as the *Average Annual Runoff in the United States, 1951-80,* which is published by the USGS, to calculate an estimate of a regional unit flow value. The map displays the U.S. with contour lines of equal average runoff. If the drainage area under investigation is in an area on the map that exhibits little variation in runoff, it may be possible to visually estimate an average runoff value. This average annual runoff value in inches can then be converted to flow per square mile (cfs/mi^2) by multiplying it by 0.07362.

(6) **For each ungauged flow point to be estimated, multiply the regional unit flow value times the watershed area determined for that point.**

$$Q_{target} = R_{region} \times A_{target}$$

EVALUATING TARGETS IN MULTIPLE WATER BODY CATEGORIES

Some targets in the surface water pathway (i.e., wetlands, other sensitive environments, fisheries) may span more than one water body category. The steps below describe how to evaluate such targets. ***Highlight 8-24*** provides an example of evaluating targets in two dilution weight categories.

(1) **For listed sensitive environments, identify all dilution weights applicable to the water bodies in which the sensitive environment is located.** Choose the dilution weight that results in the highest target value for that sensitive environment. .

(2) **For wetlands and fisheries, determine where the breakpoint(s) between the surface waters and/or water body categories occur.**

- Divide the wetland or fishery into two or more portions, based on the breakpoints determined above.

- Evaluate each portion as a separate wetland or fishery, applying the appropriate dilution weight from HRS Table 4-13.

DETERMINING SALINITY CATEGORY OF WATER BODY

The use of certain reference data to score bioaccumulation potential, ecosystem bioaccumulation potential, and ecosystem toxicity, and to select ecological-based benchmarks depends on the salinity of the water body in which targets are located. Most lakes and portions of rivers are fresh water, and oceans and most portions of coastal tidal waters are salt water. In tidally influenced waters (and certain non-tidally influenced waters), determining which data to use may be complicated by the presence of water of relatively low salinity, known as brackish water.

(1) **Gather the following Information about the surface water bodies within the TDL, as necessary and available:**

- Average tidal cycle salinity;
- Average tidal cycle chloride concentration; and
- Presence of certain aquatic organisms.

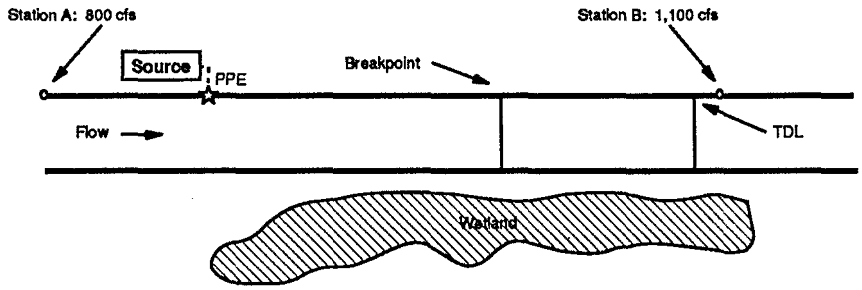
(2) **Determine if targets are located In fresh water, salt water, and/or brackish water.**

- If data on salinity or chloride concentration are available, use the definitions given at the beginning of this section to classify the water body,

- If no data are available, contact a state or Federal agency representative (e.g., National Marine Fishery Service (NMFS) personnel) or a recognized expert to provide a judgment based on the presence or absence of "indicator" species. Certain species are sensitive to salinity, and their presence may indicate fresh water. The same is true for some species that only inhabit salt water. In addition, assemblages of species are indicative of salinity gradients. Documenting salinity by use of indicator species should be supported by either a professional's statement or by scientific literature confirming the correlation of the indicator species with the water body's salinity.

- If no data or professional judgment regarding indicator species are available, assume that the portion of the river from the mouth upstream to the extent of salt water intrusion is brackish, all areas upstream from this point are fresh water, and all coastal tidal waters are salt water.

HIGHLIGHT 8-24
SCORING TARGETS IN TWO DILUTION WEIGHT CATEGORIES



The site is located adjacent to a stream. The two gauging stations located nearest the site are approximately 5 miles upstream from the PPE (Station A) and approximately 16 miles downstream from the PPE (Station B). Annual average discharge for these stations is as follows:

Station A: 800 cfs
Station B: 1,100 cfs

Wetlands are adjacent to the stream beginning at the PPE and continue for 17 miles. The entire wetland is a critical habitat for a Federal designated endangered species.

The TDL for this site includes water bodies in two different flow categories. To evaluate targets correctly, you must determine the breakpoint in the flow categories, so that the appropriate dilution weights can be assigned.

(1) **Determine the incremental flow between the two gauging stations (Q_I) and then calculate the flow per unit length (Q_L).**

Q_I = 1,100 cfs - 800 cfs = 300 cfs
Q_L = 300 cfs/21 mi = 14.3 cfs/mi

(2) **Determine breakpoint between dilution weight categories.**

800 cfs + (14.3 cfs/mi) (B mi) = 1,000 cfs
B = 200 cfs/14.3 cfs/mi = 14 mi
Breakpoint is 14 miles downstream from Station A, or 9 miles downstream of the PPE.

(3) **Score targets.**

For critical habitat, choose dilution weight that gives higher score (i.e., 0.01). Critical habitat for Federal designated endangered species receives value of 100 from HRS Table 4-23. Therefore,

Sensitive Environment Value = 100 x 0.01 = 1

For wetland, divide the wetland into two parts, and score each segment separately:

Segment A: 9 mi frontage, dilution weight = 0.01
Wetland Value = 250 x 0.01 = 2.5

Segment B: 6 mi frontage, dilution weight = 0.001
Wetland Value = 150 x 0.001 = 0.15

Potential Contamination Factor Value = 1/10 x [1 + 2.5 + 0.15] = 0.365

(3) **Select appropriate reference data, based on salinity of water body at target locations.** Determine the salinity category for each threat based on the location of targets (e.g., the food chain targets may be in salt water and the sensitive environment targets may be in fresh water).

- Select a bioaccumulation potential, ecosystem toxicity, and ecosystem bioaccumulation potential value (as needed) for the watershed.

  – If all targets for the threat are located in fresh water, use fresh water reference data values to score the appropriate factor. If the applicable fresh water data for the hazardous substances being evaluated are not available, use salt water (marine) reference data.

  – If all targets for the threat are located in salt water, use salt water reference data values to score the appropriate factor. If the applicable salt water data for the hazardous substances being evaluated are not available, use fresh water reference data.

  – If some targets for the threat are located in fresh water and others are located in salt water, or if any targets are located in brackish water, select the applicable reference data value that results in the higher score for the appropriate factor.

- Select appropriate benchmarks for each sensitive environment target subject to actual contamination.

  – If target being evaluated is located in fresh water, use the fresh water reference data value to determine a benchmark. If applicable fresh water data for the hazardous substances being evaluated are not available, use salt water reference data if available.

  – If the target being evaluated is located in salt water, use the salt water reference data value to determine a benchmark. If applicable salt water data for the hazardous substances being evaluated are not available, use fresh water reference data if available.

  – If the target being evaluated is located in both fresh water and salt water, or if it is located in brackish water, use the lower of the fresh water or marine values to determine the benchmark.

TIPS AND REMINDERS

- It may not be necessary to define precise breakpoints between water body types unless important targets are located near the breakpoints.

- If the fresh and salt water reference values are identical, do not spend significant time documenting whether waters are fresh, brackish, and/or salt. However, if reference values differ for one or more of the factors, the distinction needs to be made.

- In the case of ecological-based benchmarks for sensitive environments subject to actual contamination, the use of the lower benchmark concentration results in the higher factor score.

- Score inland waters with high salinity due primarily to sodium chloride (e.g., Great Salt Lake, Salton Sea, and saline water-draining salt beds) as brackish waters. Score inland waters with high salinity due primarily to salts other than sodium chloride (e.g., mineral springs, volcanic lakes, and playa lakes) as fresh water.

- If salinity for a water body varies significantly over time, determine water type based on the presence of fresh and/or salt water indicator species.

- HRS dilution weights are assigned based on order-of-magnitude ranges of flow or depth. Therefore, estimate flow or depth at a target with a degree of precision that places the flow or depth within one of these ranges.

- The SCS often has flow data for small (10 to 50 cfs) streams that are not gauged.

- Before applying the runoff-area method, carefully consider the watershed especially in areas where runoff patterns are highly variable (e.g., the Southwest and Pacific Northwest).

SECTION 8.4
SURFACE WATER CONTAINMENT FACTOR

This section provides definitions for many of the terms used in the surface water containment descriptions and explains how to score the containment factor in the surface water pathway. If an observed release to a watershed cannot be established, then that watershed is evaluated based on potential to release. Two factors are used to evaluate the potential to release factor: potential to release by overland flow and potential to release by flood. The containment factor is a measure of the methods (either natural or engineered) that have been used to restrict the release of hazardous substances from a source to the watershed or to prevent released substances from entering surface water.

Containment criteria have been compiled for several types of sources on a numerical scale selected to provide a relative degree of discrimination among different levels of containment. HRS Table 4-2 includes containment factor rating descriptions for the following specific categories of hazardous waste sources: surface impoundments, land treatment facilities, containers, and tanks. The table also provides containment factor rating descriptions that apply to all other hazardous waste sources, including landfills, piles, and contaminated soil.

The containment factor is evaluated for each source for the watershed being evaluated, and the highest containment factor value for any source that meets the minimum size requirement is assigned as the containment factor value. If none of the sources meets the minimum size requirement, the highest containment factor value of any source is assigned.

RELEVANT HRS SECTIONS

Section 4.1.2.1.2.1.1	Containment
Section 4.1.2.1.2.2.1	Containment (flood)
Section 4.1.2.1.2.2.2	Flood frequency
Section 4.1.2.1.2.2.3	Calculation of factor value for potential to release by flood
Section 4.1.2.1.2.3	Calculation of potential to release factor value

DEFINITIONS

The following definitions elaborate on terms used in the containment descriptions in HRS Table 4-2.

Above-ground Tank: Any tank that does not meet the definition of a below-ground tank (including any tank that is only partially below the surface).

Associated Containment Structures: As used in HRS Table 4-2, constructed barriers (e.g., liners, dikes, berms) that may have been placed under, over, or around a source (e.g., a landfill or a waste pile) to prevent the release of hazardous substances to the environment.

Below-ground Tank: A tank with its entire surface area below the surface and not visible; however, a fraction of its associated piping may be above the surface.

Bulk Liquids: Noncontainerized liquids deposited directly into a source by pipe, tanker truck or other means of transport.

Essentially Impervious Base: A base underlying containers that is free from cracks and gaps and prevents the penetration of leaks, spills, or precipitation.

Evidence of Hazardous Substance Migration: Chemical analyses and/or visual evidence that demonstrate hazardous substances attributable to a source have migrated away from that source into the surrounding soil, ground water, surface water, or air (e.g., leachate containing hazardous substances coming out of the source; stained or contaminated soil that can be attributed to migration from the source; evidence of overflow from a surface impoundment containing hazardous substances).

Free Liquids: Liquids that readily separate from the solid portion of a substance under ambient temperature and pressure.

Freeboard: Vertical distance between the top of a tank or surface impoundment dike and the surface of the hazardous substance contained therein. Freeboard is intended to prevent overtopping resulting from normal or abnormal operations, wind and wave action, rainfall, and/or run-on.

Land Treatment Zone: Soil area in the unsaturated zone of a land treatment unit within which hazardous substances are intended to be degraded, transformed, or immobilized.

Liner: A continuous barrier that covers all the earth likely to be in contact with a source so that hazardous substances or leachate containing hazardous substances would not migrate to the surrounding earth. The barrier may be synthetic material (e.g., a thick, continuous, polyethylene membrane) or engineered, compacted natural, material (e.g., re-worked and low permeability clay). An in-situ clay layer that has not been re-engineered by compaction or other methods is not considered a liner.

Maintained Engineered Cover: Vegetated cover, usually made of compacted clean soil. It is generally placed over a source at its closure and is designed and constructed to minimize the migration of liquids through the closed source, function with minimum maintenance, and accommodate settling and subsidence. Maintenance of the integrity and effectiveness of the final cover may include repairing the cap as necessary to correct the effects of settling, subsidence, erosion, and other events.

Run-on Control/Runoff Management System, Functioning and Maintained: A functioning and maintained, engineered system or structure designed to prevent flow into or onto a source or, alternatively, to control runoff from a source and prevent hazardous substance migration.

Secondary Containment: As used in HRS Table 4-2, secondary containment is applicable to the evaluation of the containment factor for tanks. Methods of secondary containment include a liner external to the tank, a vault, a double-walled tank, or an equivalent device.

Tank and Ancillary Equipment: Tanks and associated pipes, pumps, sumps, manifolds, fittings, flanges, and valves used to distribute, meter, or control flow of hazardous substances to or from the tank.

SCORING SURFACE WATER CONTAINMENT FOR OVERLAND FLOW

(1) **Identify the sources at the site.** (See Section 4.1 for discussion of potential sources.) HRS section 1.1 defines a source as "any area where a hazardous substance has been deposited, stored, disposed, or placed, plus those soils that have become contaminated from migration of a hazardous substance." The HRS divides sources into five categories for evaluating ground water containment: surface impoundments, land treatment, containers, tanks, and all other sources. Each category has a separate list of criteria used to assign containment values.

(2) **Determine If one or more sources are located In surface water in the watershed being evaluated (e.g., intact sealed drums In surface water).**

- If so, assign a containment factor value of 10 for that watershed.
- If not, continue to Step (3).

(3) **For each source within the watershed, determine whether the source hazardous waste quantity value is 0.5 or greater.**

- Only sources with a source hazardous waste quantity value of 0.5 or greater can be used to assign the containment value, unless no source for the watershed being evaluated has a source hazardous waste quantity value of 0.5 or greater. This limitation is referred to as "minimum size requirement." ***Highlight 8-25*** summarizes the measurements of sources that will give a source hazardous waste quantity value of 0.5. Any of the hazardous waste quantity tiers can be used to determine whether a source meets the minimum size requirement. Detailed guidance on determining hazardous waste quantity values is provided in Chapter 6.

- If no source meets the minimum size requirement, evaluate containment for all sources.

(4) **Assign a containment value to each eligible source.**

- Use the definitions provided above to interpret the containment criteria in HRS Table 4-2.

- ***Highlight 8-26*** summarizes the information requirements to evaluate source containment.

(5) **Assign a containment factor value for the potential to release by overland flow component for the watershed.**

- Assign the highest containment value for those sources with hazardous waste quantity values greater than or equal to 0.5 as the containment factor value for the watershed.

- If <u>none</u> of the sources in the watershed being evaluated at the site has a source hazardous waste quantity value greater than or equal to 0.5, assign the highest containment factor value from all eligible sources for the watershed as the containment factor value for the watershed.

SCORING SURFACE WATER CONTAINMENT FOR FLOOD

Assign the flood containment factor value as described below.

(1) **Identify the sources at the site.** (See Section 4.1 for discussion of potential sources.)

HIGHLIGHT 8-25
SOURCE MEASUREMENTS THAT MEET THE MINIMUM SIZE REQUIREMENT

Tier	Measure or Source Type	Minimum Measurements for Hazardous Waste Quantity Value of 0.5
A	**Hazardous constituent quantity**	0.5 pounds
B	**Hazardous wastestream quantity**	2,500 pounds
C	Landfill	1,250 cubic yards
	Surface impoundment	1.25 cubic yards
Volume	Surface impoundment (buried/backfilled)	1.25 cubic yards
	Drums	250 gallons
	Tanks and containers other than drums	1.25 cubic yards
	Contaminated Soil	1,250 cubic yards
	Pile	1.25 cubic yards
	Other	1.25 cubic yards
D	Landfill	1,700 square feet
	Surface impoundment	6.50 square feet
Area	Surface impoundment (buried/backfilled)	6.50 square feet
	Land treatment	135 square feet
	Pile	6.50 square feet
	Contaminated soil	17,000 square feet

(2) **Determine if each source meets the minimum size requirement.**

- Only sources with a source hazardous waste quantity value of 0.5 or greater can be used to assign the containment value, unless no source for the watershed being evaluated has a source hazardous waste quantity value of 0.5 or greater.

- If no source meets the minimum size requirement, evaluate containment for all sources.

(3) **Assign potential to release by flood factor value to each eligible source in the watershed.**

- Determine the floodplain category in which the source (or portion of the source) lies.

HIGHLIGHT 8-26
DATA NEEDS FOR EVALUATING SOURCE CONTAINMENT

The following types of information is helpful for evaluating the containment factor:

- The physical location of the hazardous substance(s) (e.g., buried, impounded, in a below-ground tank).
- Evidence of hazardous substance migration (e.g., overflow from surface impoundments or stained soil).
- Evidence, or lack thereof, of diking, berms or other engineered physical barriers that completely surround the source area.
- The presence of bulk and/or free liquids.
- Evidence of liners that are continuous and that would prevent the source hazardous substance(s) from coming in contact with the earth beneath (or around) the source. In the case of liners, the site Investigator may assume that there is not a liner unless evidence indicates otherwise.
- Evidence, or lack thereof, of leachate collection systems (functioning or not), and ground water monitoring systems.
- Evidence of the existence and condition of physical structures that provide protection from precipitation, and/or run-on and runoff control.

The above list Is illustrative in nature. It is meant neither to be all inclusive of the types of information that can be used to characterize the containment of any particular hazardous substance source nor to establish minimum requirements.

- Assign a floodplain frequency value (see HRS Table 4-9) for each applicable floodplain category.
- Assign a containment factor value (see HRS Table 4-8) for each floodplain category in which the source is located.
- Multiply the floodplain containment value by the floodplain flood frequency value for each floodplain in which the source is located.
- Select the highest product as the source's potential to release by flood factor value.

(4) **Assign the highest potential to release by flood factor value for the watershed from sources meeting the minimum size requirement.**

- Assign the highest potential to release by flood factor value for those sources with hazardous waste quantity values greater than or equal to 0.5 as the factor value for this component of the surface water pathway.
- If none of the sources in the watershed being evaluated at the site has a hazardous waste quantity value greater than or equal to 0.5, assign the highest potential to release by flood factor value from all eligible sources for the watershed as the factor value for this component of the surface water pathway.

TIPS AND REMINDERS

- Regardless of source type, if there is evidence of hazardous substance migration from the source, assign a containment factor value of 10 for the overland flow component for that watershed.

- Any hazardous waste quantity tier can be used to determine that a source meets the minimum size requirement.

SECTION 8.5
OVERVIEW OF ACTUAL CONTAMINATION FOR ALL THREE THREATS

This section provides guidance on establishing actual contamination in the surface water migration pathway for the drinking water, human food chain, and environmental threats. This section presents a summary table of sample types that can be used in each of the three threats. Detailed guidance for each threat is contained in subsequent sections of this chapter.

In evaluating the surface water migration pathway, a water body is subject to actual contamination if it meets specific criteria that demonstrate that hazardous substances attributable to the site have migrated to targets for the water body. Additional criteria apply for the human food chain threat (see Sections 8.12 and 8.13). Surface water bodies subject to actual contamination are classified as being subject to either Level I or Level II concentrations. Several targets factors receive higher weighting when surface water bodies are subject to actual contamination. Targets not subject to actual contamination are evaluated based on potential contamination.***Highlight 8-27*** summarizes the requirements for establishing actual contamination of a surface water body. Sections on each threat within the surface water pathway provide details on how to determine the level of contamination.

RELEVANT HRS SECTIONS

Section 2.3	Likelihood of release
Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.1.2	Target distance limit
Section 4.1.2.1.1	Observed release
Section 4.1.2.3	Drinking water threat - targets
Section 4.1.3.3	Human food chain threat - targets
Section 4.1.4.3	Environmental threat - targets

DEFINITIONS

Actual Contamination for the Surface Water Pathway: A portion of a surface water body is subject to actual contamination if it meets the criteria for an observed release. Sampling data from aqueous, sediment, or essentially sessile, benthic organisms may be used to establish actual contamination. However, the requirements for establishing actual contamination vary by threat.

Level I Concentration for the Surface Water Pathway: Level I concentrations are established in samples in which the concentration of a hazardous substance that meets the criteria for an observed release is <u>at or above</u> its specific health-based benchmark for the surface water threats, with certain exceptions for the human food chain threat. Targets also may be subject to Level I concentrations if multiple hazardous substances that meet the criteria for an observed release are present below their respective benchmarks and the I or J index is greater than or equal to one. Benchmarks for the surface water pathway include MCLs, non-zero MCLGs, Food and Drug Administration Advisory Levels (FDAAL) for fish or shellfish, ambient water quality criteria (AWQC) for protection of aquatic life, ambient aquatic life advisory concentrations (AALAC), and screening concentrations for cancer and chronic noncancer effects.

Level II Concentration for the Surface Water Pathway: Level II concentrations are established in samples in which the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met, with certain exceptions for the food chain threat. In addition, Level II is assigned for observed releases established by direct observation.

Observed Release: An observed release is established for the ground water, surface water, or air migration pathway either by chemical analysis or by direct observation. Observed release is not relevant to the HRS soil exposure pathway. The minimum requirements for establishing an observed release by chemical analysis are analytical data demonstrating the presence of a hazardous substance in the medium significantly above background level, and information that some portion of that increase is attributable to the site. The minimum criterion for establishing an observed release by direct observation is evidence that the hazardous substance was placed into or has been seen entering the medium.

HIGHLIGHT 8-27
SAMPLES AND CRITERIA FOR LEVEL I AND LEVEL II CONCENTRATIONS BY THREAT [a]

Sample Type	Drinking Water Threat	Human Food Chain Threat	Environmental Threat
Level I			
Surface Water	[C][b] must meet criteria for an observed release and be at or above concentrations corresponding to: • Non-zero MCLG, • MCL, • Oral 10^{-6} cancer risk level, or • Oral RfD.	Cannot be used to establish Level I.	[C][b] must meet criteria for an observed release and be at or above concentrations corresponding to: • AWQC for protection of aquatic life, or • AALAC.
Bethnic or Other Tissue	Cannot be used to establish Level I.	[C][b,c] must meet criteria for an observed release and be at or above concentrations corresponding to: • FDAAL for fish or shellfish, • Oral 10^{-6} cancer risk level, or • Oral Rfd.	Cannot be used to establish Level I.
Sediment	Cannot be used to establish Level I.	Cannot be used to establish Level I	Cannot be used to establish Level I.
Level II[d]			
Surface Water	[C] must meet criteria for an observed release.	[C][e,f] must meet criteria for an observed release.	[C] must meet criteria for an observed release.
Bethnic or Other Tissue	[C] must meet criteria for an observed release.	[C][c] must meet criteria for an observed release.	[C] must meet criteria for an observed release.
Sediment	[C] must meet criteria for an observed release.	[C][e,f] must meet criteria for an observed release.	[C] must meet criteria for an observed release.

[a] Only those drinking water intakes, portions of fisheries, and portions of wetlands within the boundaries of Level I or Level II contamination are considered subject to such contamination. However, if any portion of a sensitive environment other than a wetland is subject to Level I or Level II contamination, the entire sensitive environment is evaluated as that level of contamination.

[b] [C] refers to the concentration of a hazardous substance in a sample. Only one of the listed benchmarks needs to be equalled or exceeded by this concentration for Level I to be established (or, for multiple substances, the I or J index needs to exceed 1).

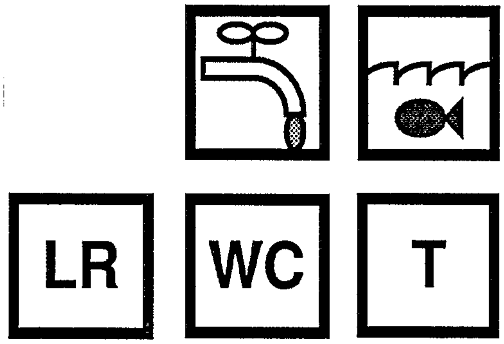
[c] Concentrations of hazardous substances must be measured in a sample from an essentially sessile benthic human food chain organism from the watershed or in a tissue sample from an organism (1) taken from a location within the boundaries of the actual food chain contamination and (2) from a species of human food chain organism that spends extended periods of time within the boundaries of the actual food chain contamination but is not an essentially sessile benthic organism. Hazardous substances in this latter type of tissue sample do not need to meet the criteria for an observed release but must meet the criteria for actual food chain contamination In a surface water, benthic, or sediment sample.

[d] Level II contamination in all threats also is established by an observed release by direct observation.

[e] The hazardous substance also must have a bioaccumulation potential factor value greater than or equal to 500, with certain exceptions for a closed fishery.

[f] A fishery also may be considered subject to Level 11 contamination if the fishery is closed, a hazardous substance for which the fishery has been closed has been documented In an observed release to the watershed from the site, and at least a portion of the fishery is within the boundaries of the observed release. The bloaccumulation potential factor value greater than or equal to 500 does not apply in this case.

SECTION 8.6
EFFICIENCY OF SCORING THE DRINKING WATER THREAT



The drinking water threat is one of three threats used to evaluate the surface water pathway; the other two are the human food chain threat and the environmental threat. The drinking water threat for each watershed is evaluated based on three factor categories: likelihood of release, waste characteristics, and targets. The drinking water threat targets factor category reflects the human population and resources potentially at risk from exposure to hazardous substances in the surface water. Three factors are used to evaluate drinking water threat targets: nearest intake, population, and resources. Populations and intakes actually exposed to contaminated drinking water are weighted more heavily than those potentially exposed.

This section provides guidance for estimating the score that can be expected from the drinking water threat before the detailed scoring and documentation process begins. This is done by presenting look-up tables that provide rough estimates of drinking water threat scores based on estimates for the likelihood of release, waste characteristics, and population factors. Such a determination may already have been made during the PA and/or SI. This section provides guidance on how to estimate the drinking water threat score when a single water body is present. If more than one water body is present within the watershed, the scorer should estimate the score of the water body with the greatest population served by drinking water intakes to determine the efficiency of scoring this threat. However, this method may underestimate the actual drinking water threat. This section is intended to be used as a general guideline and not as an absolute determination of whether to score the drinking water threat.

DEFINITIONS

Actual Contamination for a Drinking Water Intake: A drinking water intake is subject to actual contamination if it is located in a portion of a surface water body that meets the criteria for an observed release.

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination as a function of the flow or depth of the water body at the target.

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

ESTIMATING ACTUAL CONTAMINATION

Score the drinking water threat whenever a drinking water intake is considered subeect to actual contamination (i.e., Level I or Level II concentrations). Because populations and nearest intake subject to actual contamination receive higher weight and higher scores, respectively, than those subject to potential contamination, the drinking water threat score based on actual contamination may be sufficient for NPL consideration. ***Highlight 8-28*** provides an analysis of approximate drinking water threat scores obtained when intakes are subject to actual contamination. If intakes subject to potential contamination are also present, consider whether documenting the population served by these additional intakes will significantly affect the pathway score. At a minimum, discuss the presence of intakes subject to potential contamination in the documentation record even if they are not scored.

ESTIMATING POTENTIAL CONTAMINATION

Many factors must be scored when evaluating the drinking water threat based on potential contamination. This section provides a step-wise procedure and look-up tables that can be used to estimate the drinking water threat score for a site before beginning the detailed documentation process. <u>If a preliminary score has been developed for the site during the PA or SI, many of the estimates in the steps below will already have been made</u>. In this case, proceed to Step (3).

(1) **Estimate the waste characteristics factor category value.** The waste characteristics factor category value generally will not vary significantly among the migration pathways (except for the human food chain threat and environmental threat). If you have already determined the waste characteristics factor category value for the ground water pathway (or any other migration pathway), use it to approximate the value (although the drinking water threat waste characteristics are based on toxicity/persistence rather than toxicity/mobility). Note that if the drinking water threat is actually scored, waste characteristics must be determined as outlined in HRS sections 4.1.2.2 and 4.2.2.2 (i.e., do not use any estimated values for actual HRS scoring).

HIGHLIGHT 8-28
APPROXIMATE DRINKING WATER THREAT SCORES FOR POPULATION SUBJECT TO ACTUAL CONTAMINATION [a]

Contamination Type	Likelihood of Release	Nearest Intake	Waste Characteristics	Population Served by Intake(s)							
				1	5	10	25	50	100	250	500
Level I	550	50	100	43	70	100	100	100	100	100	100
			56	24	39	58	100	100	100	100	100
			32	14	22	33	65	100	100	100	100
			18	8	13	19	37	67	100	100	100
			10	4	7	10	20	37	70	100	100
Level II	550	45	100	34	37	40	50	67	100	100	100
			56	19	21	22	28	37	56	100	100
			32	11	12	13	16	21	32	64	100
			18	6	7	7	9	12	18	36	66
			10	3	4	4	5	7	10	20	37

[a] These drinking water threat scores are rounded to the nearest integer and assume a resources factor value equal to 5. Likelihood of Release Is assigned a value of 550 If an observed release to surface water can be established.

(2) **Determine the type of surface water body and, If appropriate, estimate the flow (or depth).** The targets factor value for intakes subject to potential contamination is derived using dilution weights based on the flow or depth at the intake. If available, use actual flow and/or depth data. If data for flow are not readily available, estimate the flow according to instructions in Section 8.3 of this guidance. After an estimate for flow and/or depth is obtained, use HRS Table 4-13 to determine the water body type and the appropriate dilution weight.

(3) **Estimate the population served by drinking water Intakes subject to potential contamination within the TDL.** Determine the approximate number of people with sufficient accuracy to determine the population range category (from HRS Table 4-14) for all intakes subject to potential contamination within the TDL. Section 3.6.2 of EPA's *Guidance for Performing Preliminary Assessments* (OSWER Publication 9345.0-01 A, September 1991) provides guidance on obtaining population counts for each intake.

(4) **Determine approximate maximum drinking water threat score for a single water body In the watershed.** Use the table in ***Highlight 8-29*** to determine the approximate maximum drinking water threat score for the water body. As a first approximation, assume a likelihood of release factor category value of 550 (there can be an observed release without actual contamination of targets). The resultant threat score may indicate whether it is worthwhile to score the drinking water threat. Note that the watershed score requires combining scores from all water bodies in the watershed and could be significantly higher than a score based on a single water body. If it appears to be efficient to score the drinking water threat, proceed to Step (5). If a very low score is obtained even assuming maximum likelihood of release, then documenting potential drinking water contamination is probably not an efficient use of scoring resources, unless those few points will be important to the total site score. If not, stop here.

(5) **Estimate the likelihood of release factor category value.** Likelihood of release consists of observed release and two types of potential to release: potential to release by overland flow, and potential to release by flood. The value for potential to release by overland flow is calculated based on three factors: containment, runoff, and distance to surface water. The value for potential to release by flood is calculated based on two factors: containment (flood) and flood frequency. The values assigned to the watershed for potential to release by overland flow and potential to release by flood are summed, and this sum is assigned as the likelihood of release value, with a maximum value of 500. Section 3.6 of EPA's *Guidance for Performing Preliminary Assessments* (OSWER Publication 9345.0-01 A, September 1991) provides information on estimating a value for likelihood of release.

(6) **Determine the approximate drinking water threat score.** Using the value estimated for likelihood of release in Step (5), determine the approximate drinking water threat score for this water body by using the table in ***Highlight 8-29,*** based on the population estimated in Step (3). Because the scores in the table in ***Highlight 8-29*** include the nearest intake and resources factor values, scores for intakes on two different water body types cannot be added to get a pathway score. (Adding them would result in double counting the nearest intake and resources factor values.)

Highlight 8-30 provides an example of how to use the table in ***Highlight 8-29.***

HIGHLIGHT 8-29
APPROXIMATE DRINKING WATER THREAT SCORES FOR POPULATION SUBJECT TO POTENTIAL CONTAMINATION [a]

Likeli-hood of Release	Waste Char.	Water BodyType[b]	Popuation Served by Intake(s)						
			31-100	101-300	301-1,000	1,001-3,000	3,001-10,000	10,001-30,000	30,001-100,000
550[c]	100	minimal stream	20	28	51	100	100	100	100
		3-mile mixing zone	12	15	27	64	100	100	100
		small to moderate steam	5	6	8	16	39	100	100
		all other water bodies[d]	4	4	4	5	7	14	38[e]
	56	minimal stream	11	15	29	70	100	100	100
		3-mile mixing zone	7	9	15	36	100	100	100
		small to moderate steam	3	3	5	9	22	64	100
		all other water bodies[d]	2	2	2	3	4	8	21[e]
	32	minimal stream	6	9	16	40	100	100	100
		3-mile mixing zone	4	5	9	21	59	100	100
		small to moderate steam	2	2	3	5	13	36	100
		all other water bodies[d]	1	1	1	1	2	5	12[e]
400	100	minimal stream	15	20	37	91	100	100	100
		3-mile mixing zone	9	11	20	47	100	100	100
		small to moderate steam	4	4	6	11	29	82	100
		all other water bodies[d]	3	3	3	3	5	10	28[e]
	56	minimal stream	8	11	21	51	100	100	100
		3-mile mixing zone	5	6	11	26	75	100	100
		small to moderate steam	2	2	3	6	16	46	100
		all other water bodies[d]	1	1	2	2	3	6	16[e]

(Continued on next page)

HIGHLIGHT 8-29 (continued)
APPROXIMATE DRINKING WATER THREAT SCORES FOR POPULATION SUBJECT TO POTENTIAL CONTAMINATION [a]

Likeli-hood of Release	Waste Char.	Water Body Type[b]	Population Served by Intake(s)						
			31-100	101-300	301-1,000	1,001-3,000	3,001-10,000	10,001-30,000	30,001-100,000
	32	minimal stream	5	6	12	29	85	100	100
		3-mile mixing zone	3	4	6	15	43	100	100
		small to moderate stream	1	1	2	4	9	26	82
		all other water bodies[d]	1	1	1	1	2	3	9[e]
300	100	minimal stream	11	15	28	68	100	100	100
		3-mile mixing zone	7	8	15	35	75	100	100
		small to moderate stream	3	3	4	8	21	62	100
		all other water bodies[d]	2	2	2	3	4	8	21[e]
	56	minimal stream	6	8	16	38	100	100	100
		3-mile mixing zone	4	5	8	20	56	100	100
		small to moderate stream	2	2	2	5	12	35	100
		all other water bodies[d]	1	1	1	1	2	4	12[e]
	32	minimal stream	3	5	9	22	64	100	100
		3-mile mixing zone	2	3	5	11	32	97	100
		small to moderate stream	1	1	1	3	7	20	61
		all other water bodies[d]	1	1	1	1	1	2	7[e]

[a]These drinking water threat scores assume a resources factor value equal to 5 and incorporate the appropriate nearest Intake factor, Consequently, scores from this table cannot be summed to provide an estimated score for intakes on different water body types.

[b] All water bodies with a dilution weight equal to or less than 0.01 are grouped together in the category "all other water bodies." The drinking water threat scores in this grouped row are equal to that of the "moderate to large stream" category, but the scores of the larger water bodies are generally sufficiently close that the "all other water bodies" category will serve as a useful approximation for all water bodies included in the category (except where otherwise noted).

[c] Note that it is possible to score an observed release to a watershed but still have all targets scored under potential contamination.

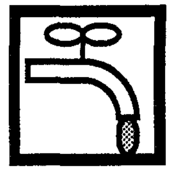
[d] Lakes with flow characteristics similar to the first three water body types would have values similar to the first three water body types.

[e] These drinking water threat scores will be substantially lower for water bodies larger than a moderate to large stream.

HIGHLIGHT 8-30
EXAMPLE OF ESTIMATING DRINKING WATER THREAT SCORE

Site Description:	The site is adjacent to surface water. Waste characteristics have been scored at 100.
Water Body Type:	The hazardous substance migration path involves only one stream approximately 30 feet in width. Estimated flow is approximately 70 cfs, indicative of a "small to moderate stream."
Population Estimate:	Population served by all intakes along the stream is between 1,001 and 3,000. All population is subject to potential contamination.
Maximum Estimated Drinking Water Threat Score:	Given these parameters, the estimated maximum drinking water threat score for the site Is 16 based on potential contamination. This score of 16 is assumes that the likelihood of release Is scored at its maximum value (i.e,, 550 points for an observed release). If scoring the drinking water threat would appear to affect the site score significantly, then the actual likelihood of release would be estimated in order to arrive at a closer approximation of the drinking water threat score. If the stream had been In the "moderate to large stream" category, the maximum drinking water threat score would have been 5.

SECTION 8.7
ACTUAL CONTAMINATION IN THE DRINKING WATER THREAT



T

A drinking water intake is subject to actual contamination if it meets specific criteria that demonstrate that the intake has been contaminated with hazardous substances attributable to the site. See Section 8.5 for general guidance on establishing actual contamination of targets in the surface water pathway. All intakes subject to actual contamination are classified as Level I or Level II. Drinking water intakes subject to actual contamination receive higher values for the nearest intake factor and higher weight for the population factor than intakes subject to potential contamination. This section provides guidance on differentiating between Level I and Level II contamination, including information on the types of samples and health-based benchmarks that can be used. Information on scoring the drinking water threat for sites with intakes subject to actual contamination is also provided in this section.

RELEVANT HRS SECTIONS

Section 2.5	Targets
Section 2.5.1	Determination of level of actual contamination at a sampling location
Section 2.5.2	Comparison to benchmarks
Section 4.1.1.2	Target distance limit
Section 4.1.2.3	Drinking water threat - targets
Section 4.1.2.3.1	Nearest intake
Section 4.1.2.3.2	Population
Section 4.1.2.3.2.1	Level of contamination
Section 4.1.2.3.2.2	Level I concentrations
Section 4.1.2.3.2.3	Level II concentrations

DEFINITIONS

Actual Contamination for a Drinking Water Intake: A drinking water intake is subject to actual contamination if it is located in a portion of a surface water body that meets the criteria for an observed release.

Level II Concentrations for the Drinking Water Threat: Level I concentrations are established in aqueous samples in which the concentration of a hazardous substance that meets the criteria for an observed release is <u>at or above</u> its drinking water benchmark. A drinking water intake also may be subject to Level I concentrations if multiple hazardous substances that meet the criteria for observed release are present below their respective benchmarks, and the I or J index is greater than or equal to one. Benchmarks for the drinking water threat include MCLGs, MCLs, and screening concentrations for cancer and chronic noncancer effects.

Level II Concentrations for the Drinking Water Threat: Level II concentrations are established in samples in which the concentration of at least one hazardous substance meets the criteria for an observed release, but the conditions for Level I concentrations are not met. In addition, Level II is assigned for observed releases established by direct observation.

Nearest Intake Factor: Factor for evaluating the maximally exposed intake. This factor is based on the presence of actual contamination or, for watersheds where no intake is subject to actual contamination, the flow or depth of the water body at the intake nearest to the PPE within the TDL.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Target Distance Limit (TDL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL Is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

ESTABLISHING ACTUAL CONTAMINATION FOR A DRINKING WATER INTAKE

The steps outlined below describe how to establish actual contamination for a drinking water intake. These steps should be repeated for multiple hazardous substances and/or samples as necessary.

(1) **Determine if an observed release can be established by direct observation.** If an observed release is established by direct observation, actual contamination of a drinking water intake can be established only if the observation is made at the location of the drinking water intake. Direct observation cannot be used to establish Level I concentrations.

(2) **Identify sampling locations that can establish actual contamination for the intake based on chemical analysis.** Surface water, sediment, or benthic samples taken at, or downstream from, a drinking water intake can be used to establish actual contamination for the intake. Select one hazardous substance in one of these samples and proceed to Step (3). If no such sampling locations are identified and actual contamination is not established based on direct observation, score the intake based on potential contamination.

(3) **Determine the background level for the hazardous substance.** Determine the appropriate background level (e.g., concentration from an appropriate background sample) for hazardous substances that could be naturally occurring, ubiquitous, or attributable to other sources in the area. A background level of 0 can be assumed for substances that are neither naturally occurring, ubiquitous, nor attributable to other sources in the areas (i.e., a background sample may not be needed). See Section 5.1 for detailed information on determining the appropriate background level for comparison with a sample.

(4) **Determine whether the concentration of the hazardous substance is significantly above background.** If yes, proceed to Step (5); if no, select another hazardous substance and/or sample and return to Step (3). Detailed guidance for making this determination is found in Section 5.1, particularly ***Highlight 5-2.***

(5) **Determine if the hazardous substance can be attributed to the site.** If yes, actual contamination is established; if no, select another hazardous substance and/or sample and return to Step (3). Obtain sampling results or records (e.g., manifests) indicating the presence of the hazardous substance in a source at the site. Information that the hazardous substance was used at the facility also may be acceptable. See Sections 5.1 and 5.3 for additional guidance on attribution and transformation products.

DETERMINING LEVEL OF CONTAMINATION

After identifying intakes within the TDL and establishing whether the intake is subject to actual contamination, determine the level of contamination for the intake. The steps outlined below describe how to determine if the intake should be scored as Level I, Level II, or potential contamination.

(1) **Determine whether actual contamination can be established for the surface water intake for any detected hazardous substance.** Follow the guidance in the above section, Establishing Actual Contamination for a Drinking Water Intake. See ***Highlight 8-27*** for a summary of the types of samples and criteria used to establish the level of contamination for the drinking water threat.

- If actual contamination cannot be established for the intake (e.g., there is neither sampling data nor direct observation), score the drinking water intake based on potential contamination.

- If actual contamination can be established for the intake, proceed to Step (2).

(2) **Evaluate the level of contamination for the intake, based on the data used to establish actual contamination at that intake.**

- For sites that consist of <u>contaminated sediments with an unknown source</u>, evaluate all intakes subject to actual contamination as Level II, regardless of the surface water concentration of hazardous substances at an intake.

- If actual contamination is established by <u>direct observation</u>, evaluate the intake based on Level II concentrations.

- If actual contamination is established using only <u>sediment or benthic samples</u> (i.e., actual contamination cannot be established for that intake using surface water samples), evaluate the intake based on Level II concentrations.

- If actual contamination is established by surface water samples, compare the concentration of each hazardous substance that meets the observed release criteria with its appropriate health-based benchmark for surface water. See **Highlight 8-31** for a list of applicable benchmarks.

  — If the concentration of any hazardous substance that meets the observed release criteria is greater than or equal to its benchmark, evaluate the intake based on Level I concentrations.

  — If no hazardous substance that meets the observed release criteria intake has an applicable health-based benchmark, evaluate the intake based on Level II concentrations.

  — If only one hazardous substance meets the observed release criteria intake and its concentration is less than its benchmark, evaluate the intake based on Level II concentrations.

HIGHLIGHT 8-31
BENCHMARKS FOR THE DRINKING WATER THREAT

The following benchmarks apply to the drinking water threat. Values for specific hazardous substances are available in SCDM under the health-based benchmarks section. For evaluating the drinking water threat, these benchmarks are applicable to surface water samples only (i.e., do not use with sediment or benthic samples). If several benchmarks are provided for a substance, choose the benchmark with the lowest concentration. For some hazardous substances, values are not available for all benchmarks.

- MCLG (use only values greater than 0).
- MCL.
- Screening concentration for cancer, corresponding to a 10^{-6} individual cancer risk for oral exposures.
- Screening concentration for noncancer effects, corresponding to the RfD for oral exposures.

— If more than one hazardous substance meets the observed release criteria intake and none of these substances exceeds its applicable benchmark, continue to Step (3).

(3) **Calculate the I and J indices for all hazardous substances that meet the observed release criteria.** Make two lists of substances that meet the observed release criteria: hazardous substances with screening concentrations for cancer risk, and hazardous substances with screening concentrations for noncancer effects. Each hazardous substance may be on one, neither, or both of the lists. If more than one sample has been taken, and these samples are comparable (e.g., taken in the same time frame, collected using the same field techniques, analyzed by the same methods), then for each hazardous substance select the highest concentration to use in the calculations below.

- Calculate the I index for all hazardous substances with screening concentrations for cancer risk that meet the observed release criteria, using the following equation:

$$I = \sum_{i=1}^{n} \frac{C_i}{SC_i}$$

where: C_i = concentration of substance i in sample;
SC_i = screening concentration for cancer risk for hazardous substance i; and
n = number of hazardous substances that meet observed release criteria and for which an SC is available.

- Calculate the J index all hazardous substances with screening concentrations for noncancer effects that meet the observed release criteria, using the following equation:

$$J = \sum_{j=1}^{m} \frac{C_j}{CR_j}$$

where: C_j = concentration of substance j in sample;
CR_j = screening concentration for noncancer effects for hazardous substance j; and
m = number of hazardous substances that meet observed release criteria and for which a CR is available.

- If either the I or J index is greater than or equal to 1, evaluate the drinking water intake based on Level I concentrations. If both the I and J indices are less than one, evaluate the surface water intake based on Level II concentrations.

SCORING INTAKES SUBJECT TO ACTUAL CONTAMINATION

The level of contamination must be determined to score the nearest intake and population factors and may affect the minimum value for the hazardous waste quantity factor. Once the level of contamination has been established for each intake within the TDL, score these targets as shown in **Highlight 8-32**. Section 8.8 provides detailed instructions for scoring nearest intake and population factors for intakes subject to actual contamination.

HIGHLIGHT 8-32
COMPARISON OF SCORING LEVEL I, LEVEL II, AND POTENTIAL CONTAMINATION

Level of Contamination	Nearest intake Factor Value	Population Factor Value	Minimum HWQ Factor Value[a]
Actual – Level I	50	10 x number of people	100
Actual – Level II	45	1 x number of people	100
Potential	(dilution weight) x 20	0.1 x dilution-weighted population	10[b]

[a] Minimum hazardous waste quantity factor values apply if Tier A is not adequately determined for all sources.
[b] May be 100 in certain cases when there has been a removal action; see HRS section 2.4.2.2 and EPA's removal policy fact sheet.

TIPS AND REMINDERS

- Actual contamination cannot be established without an observed release to surface water, but an observed release to surface water is not necessarily sufficient to document actual contamination of a drinking water intake.

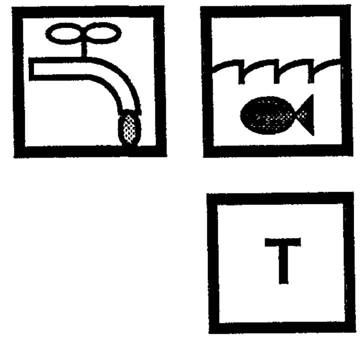
- Benthic tissue and sediment samples cannot be used to establish Level I concentrations for the drinking water threat, but can be used to establish Level II concentrations. Only analytical data from surface water samples can be used to establish Level I concentrations.

- To use multiple hazardous substances to establish Level I concentrations using the I or J index, all hazardous substance concentrations must be from the same sample or comparable samples, Comparable samples are samples taken at essentially the same location and at essentially the same time, and analyzed by equivalent methods.

- The area of actual contamination and the level of actual contamination within that area can vary for each of the three surface water threats.

- Intakes at sites that consist solely of contaminated sediments with an unknown source cannot be evaluated at Level I, regardless of surface water concentrations at the intake.

SECTION 8.8 POPULATION AND NEAREST INTAKE FACTORS



The population factor in the drinking water threat evaluates the number of residents, students, and workers regularly served by surface water intakes within the TDL for the watershed being evaluated. This evaluation is essentially the same as that for the ground water pathway, except that surface water intakes are considered instead of drinking water wells. This section also briefly discusses the nearest intake factor.

RELEVANT HRS SECTIONS

Section 4.1.1.2	Target distance limit
Section 4.1.2.3.1	Nearest intake
Section 4.1.2.3.2	Population

DEFINITIONS

Dilution Weight: A unitless parameter that adjusts the assigned point value for certain targets subject to potential contamination as a function of the flow or depth of the water body at the target.

Nearest Intake Factor: Factor for evaluating the maximally exposed intake. This factor is based on the presence of actual contamination or, for watersheds where no intake is subject to actual contamination, the flow or depth of the water body at the intake nearest to the PPE within the TDL.

Population for the Drinking Water Threat: Number of residents, students, and workers regularly served by surface water intakes that are located within the TDL for the surface water bodies evaluated for a given watershed. This population does not include transient populations, such as hotel and restaurant patrons, but may include seasonal populations (e.g., a resort area).

Students: Full- or part-time attendees of an educational institution or day care facility that is served by an intake located within the TDL.

Target Distance Limit (TDIL) for the Surface Water Migration Pathway: Distance over which the in-water segment of the hazardous substance migration path is evaluated. The TDL extends 15 miles from the PPE in the direction of flow (or radially in lakes, oceans, or coastal tidal waters) or to the most distant sample point establishing an observed release, whichever is greater. In tidally influenced surface water bodies, an upstream TDL is also determined. For some sites (e.g., sites with multiple PPEs), an overall target distance of greater than 15 miles may result.

Workers: Permanent employees (part-time or full-time) of a facility or business that is served by an intake within the TDL.

EVALUATING THE DRINKING WATER POPULATION FACTOR

The steps below describe an approach for estimating the population served by surface water intakes located within the TDL. First, estimate the population served by municipal water systems with intakes within the TDL. Contact municipal water authorities to obtain estimates of populations served. The water authority should know whether the population served includes workers and students in addition to residents. If the population estimate does not include workers and/or students, modify the methodology presented below as necessary.***Highlight 8-33*** summarizes the information needed to obtain drinking water population estimates.

HIGHLIGHT 8-33
DATA NEEDS FOR DRINKING WATER THREAT POPULATION

Obtain from Local, Municipal, or Other Water Authorities:

- Identification of all municipal surface water intakes located within the TDLs for surface water bodies in the watershed being evaluated;
- Number of persons saved or service connections for each intake that is not part of a blended system; and
- For intakes that are part of a blended system:
  - — Total population served or number of service connections;
  - — Total number of wells and intakes in the system (including those outside the TDL);
  - — Whether any wells or intakes are standby;
  - — Whether any well or intakes provides mote than 40 percent of the system's water; and
  - — Average annual pumpage or capacity for each intake and well (only needed if one intake or well provides more than 40 percent of the systems's water).

Obtain from Local, Municipal, or Other Water Authorities, or Local Health Agencies:

- Identification of private intakes located within the TDL; and
- Identification of schools and large businesses possibly served by intakes located within the TDL.

Obtain from U.S. Bureau of Census Reports (or more recent source if appropriate):

- Average number of persons per residence for each county served by a system with intake located within the TDL.

Obtain from Business and Schools:

- Information on how they obtain water; and
- Number of workers and/or students.

If the water authority can only provide the total number of connections, estimate the population using the following process.

(1) **Identify all municipal systems with intakes within the TDL.** Repeat Steps (2) through (4) for each system if more than one system has intakes within the TDL. If no municipal systems have intakes within the TDL, proceed to Step (5).

(2) **Identify all water supply units that are components of the municipal system.** These units may include surface water intakes, ground water wells, and standby intakes or wells. If the municipal system is a blended system, all water supply units – both within and outside of the TDL – must be identified.

(3) **Evaluate the population served by the municipal system, assuming all service connections are <u>residential</u>.** This assumption may underestimate the target population because typically more people are served at a school or business than at a residence. However, if a high score is achieved assuming only residential connections, time-consuming inquiries to document student or worker populations may not be necessary.

- **Identify locations of surface water intakes.** Contact local water authorities to determine the locations of surface water intakes within the TDL and applicable blended intakes outside the TDL. Mark the locations on a map that includes the PPE and surface water sample collection points.

- **Identify any Intakes contaminated at Level I or Level II.** Section 8.7 provides instructions for identifying intakes subject to Level I and Level II concentrations. Keep a separate count of persons served by intakes that are subject to Level I concentrations, Level II concentrations, and potential contamination.

- **Estimate the flow or depth for the surface water body at each intake.** This information may be available from the water authority for major drinking water intakes. If flow at the intake has not been gauged, refer to Section 8.3 for guidance on estimating flow for each intake. Flow (or for some types of water bodies, depth) is used to assign a water body type for the purpose of dilution weighting.

- **Estimate population served by municipal intakes, assuming all service connections are residential.**

  — <u>Independent systems</u>. If an intake serves an independent system (i.e., a single intake serves a particular group of residences and is not blended with water from ground water wells or other surface water intakes), determine the number of service connections. Multiply the number of service connections by the county average number of persons per residence (available from U.S. Bureau of the Census reports). Tabulate the number of persons served for each independent system intake within the TDL, by level of contamination; for intakes subject to potential contamination, tabulate by water body type.

  — <u>Blended systems</u>. If the intakes are part of a blended system, obtain information about the entire system so that the total population served can be apportioned to each intake or well. The necessary data include:

    — total number of people served or service connections for the blended system,
    — number of surface water intakes inside the TDL,
    — number of surface water intakes outside the TDL,
    — number of ground water wells in the system,

— whether any individual well or intake provides more than 40 percent of the water to the system, and
— whether any wells or intakes are standby wells or intakes.

If any well or intake provides more than 40 percent of the water to the system, obtain annual average pumpage or capacity data for each intake or well (standby intakes or wells require slightly different information; refer to Section 8.10). Apportion the population served to the intakes and wells in the blended system, following the guidance given in Section 8.9. Multiply the number of service connections assigned to each intake within the TDL by the average number of persons per residence. Tabulate the number of persons served for each intake within the TDL, by level of contamination; for intakes subject to potential contamination, tabulate by water body type.

(4) **Calculate a population factor value for the drinking water threat assuming all service connections are residential.** ***Highlight 8-34*** provides an example of the tabulation of populations and calculation of the population factor value.

- Tabulate the total number of persons served by all drinking water intakes within the TDL by (1) level of contamination (i.e., Level I, Level II, potential) and (2) water body type for intakes subject to potential contamination.

- For intakes subject to Level I concentrations, multiply the number of individuals served by 10 to calculate the Level I concentrations factor value.

- For intakes subject to Level II concentrations, the number of individuals served is the Level II concentrations factor value.

- For intakes subject to potential contamination, assign a dilution-weighted population value for each water body type using HRS Table 4-14. Sum the dilution-weighted population values assigned for each water body type. Multiply the result by 0.1 to obtain the potential contamination factor value. If the potential contamination population factor value is less than 1, do not round to the nearest integer. If it is greater than 1, round to the nearest integer.

- Sum the factor values assigned for Level I, Level II, and potential contamination to obtain the population factor value (for municipal intakes, assuming residential concentrations only).

(5) **Determine if student or worker populations should be documented.** This evaluation may involve a number of considerations, including those listed below.

- **Surface water pathway score assuming all residential connections.** If the surface water pathway score for the site is over 100 points assuming all service connections are residential, it may not be cost-effective to document the student or worker populations for scoring purposes. The presence of student or worker populations served by intakes within the TDL, however, should be noted in the documentation record.

- **Position within ranges for determining dilution-weighted population value.** If the population served by municipal intakes drawing from a particular water body type is in the lower part or middle of a broad range (HRS Table 4-14), documenting the population served at schools or businesses may not change the population factor value. If the population is near the upper end of a range, however, a substantially higher population factor value might be achieved by documenting the additional

HIGHLIGHT 8-34
DOCUMENTING DRINKING WATER THREAT POPULATION

LEVEL I CONCENTRATIONS		
Level I Intake	**Population (individuals)**	**Reference[a]**
None	–	–
		Level I Concentrations Factor Value: 0

LEVEL II CONCENTRATIONS		
Level II Intake	**Population (individuals)**	**Reference[a]**
I-1	34,000	32, 18, 21
		Level II Concentrations Factor Value: 34,000 x 1 = 34,000

POTENTIAL CONTAMINATION			
Potential Intake Water Body Type	**Population (individuals)**	**Dilution-weighted Population Value**	**Reference[a]**
I-2 large stream to river	34,000	52	32, 33, 25
I-3 large river	34,000	5	32, 33, 25
			Potential Contamination Factor Value: [52 + 5] x 0.1 = 5.7, which is rounded to 6
			TOTAL POPULATION FACTOR VALUE: 34,000 + 6 = 34,006

[a] The numbers in the reference column would identify particular references in the HRS scoring package.

population served at schools or businesses. If the population is near the lower end of a range, evaluating the student or worker population may help solidify the score.

To document student/worker populations, continue to Step (6); otherwise continue to Step (8).

(6) **Document student and/or worker populations served by municipal systems.**

- **Identify schools and businesses served by intakes within the TDL.** Obtain from water authorities information on the schools and businesses they serve.
  - — Document any schools or businesses served by intakes subject to actual contamination.
  - — For potential contamination, focus efforts on large schools (e.g., universities) or businesses and on those served by intakes on small water bodies.
- **Document the number of students or workers.**
  - — Contact the school officials to document student population.

— Contact the individual businesses to document worker population or refer to business census data. The local Chamber of Commerce may be able to provide helpful data.

(7) **Calculate a population factor value that includes the student/worker populations.** See Step (4). Make sure not to double count drinking water system connections as both residential and serving students or workers.

(8) **Determine if private intakes should be documented.** This determination involves the same considerations listed in Step (5). In addition, any private intake subject to actual contamination should be documented. If documenting private intakes is necessary, proceed to Step (9). If not, evaluation of the population factor is complete.

(9) **Evaluate population served by private intakes within the TDL.** If private intakes are identified, contact the owners to determine if the intakes are used for drinking water.

(10) **Revise the previous tabulation of drinking water population.** Add the number of persons served by private intakes to the appropriate population totals according to level of contamination and, for those subject to potential contamination, water body type.

(11) **Calculate a population factor value that includes populations served by private intakes.** Follow the procedure outlined in Step (4).

Highlight 8-35 provides an example of scoring the population factor for the drinking water threat.

HIGHLIGHT 8-35
EXAMPLE OF SCORING DRINKING WATER POPULATION FACTOR

Water Supply: Independent system consisting of a single surface water Intake located approximately ½ mile downstream from the PPE on a moderate to large stream (7OO cfs).

Population Served: The total number of service connections for this system is 1,500. The entire area served by the system lies within one county. 1990 Census data Indicate that the average number of persons per residence for that county is 2.8. <u>Assuming that all connections are residential</u>, the total population served by the system is:

1,500 x 2.8 = 4,200 people

Evaluation: The intake is subject to potential contamination. Use HRS Table 4-14 to assign a dilution-weighted population value.

The population served by this intake gives the following potential contamination factor value:

Potential contamination factor value = 1/10 x 52 = 5.2, rounded to 5

Because this is the only drinking water intake within the TDL,

Population factor value = 5.

EVALUATING THE NEAREST INTAKE FACTOR

(1) **Determine if any drinking water intake for the watershed being evaluated is subject to actual contamination.** If not, continue to Step (2). If so, score the nearest well factor as follows:

- If any drinking water intake is subject to Level I concentrations, assign a factor value of 50.

- If any drinking water intake is subject to Level II concentrations, but no intake is subject to Level I concentrations, assign a factor value of 45.

(2) **Identify the nearest drinking water intake within the TDL for the watershed being evaluated.** Measure from the PPE (or, for contaminated sediments with no identified source, from the point where measurement of TDLs begins).

(3) **Assign a dilution weight to the nearest intake.** Use HRS Table 4-13 to assign a dilution weight based on the type of surface water body in which the intake is located.

(4) **Calculate the nearest intake factor value.** Multiply the dilution weight from Step (3) by 20. Round the product to the nearest integer, and assign the result as the nearest intake factor value.

TIPS AND REMINDERS

- Determine target populations by the location of the intake, not the location of the residence, school, or workplace served by the intake.

- If a drinking water system includes portions of more than one county and the specific number of residences supplied in each county is known, use county-specific estimates of persons-per-residence. Otherwise, use the lowest known persons-per-residence figure for the applicable counties to estimate the entire population served.

- The definition of students may include students at nontraditional schools (e.g., fire training class, truck driving school). Use the school's daily average enrollment as the figure for number of students. For example, if the school has four classes per year, each lasting three months and each with an enrollment of 30 students, then the number of students is thirty.

- For water bodies other than small streams, dilution weights are very small. Consequently, intakes subject to potential contamination often result in relatively few targets points, even if they serve a large population.

- Private intakes subject to actual contamination (particularly Level I) can result in a substantial drinking water threat score. Because of the broad population ranges used to evaluate intakes subject to potential contamination and the small dilution-weighting factors for all but the smallest water bodies, private intakes subject to potential contamination generally will not increase the drinking water threat score based on municipal intakes.

- Include the population using intakes closed because of site-related actual contamination in estimating the drinking water population. This population should reflect the number of people using the intake at the time it was closed.